NOVEMBER 1958

Power Engineering

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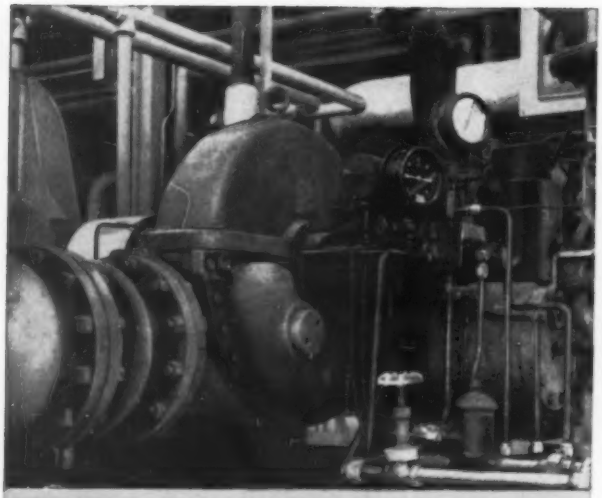
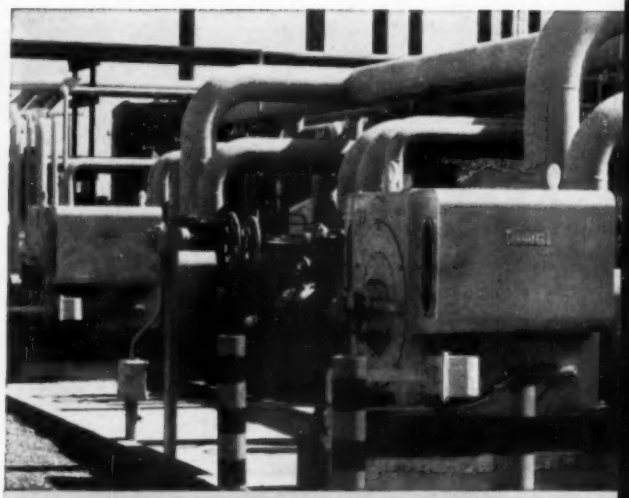
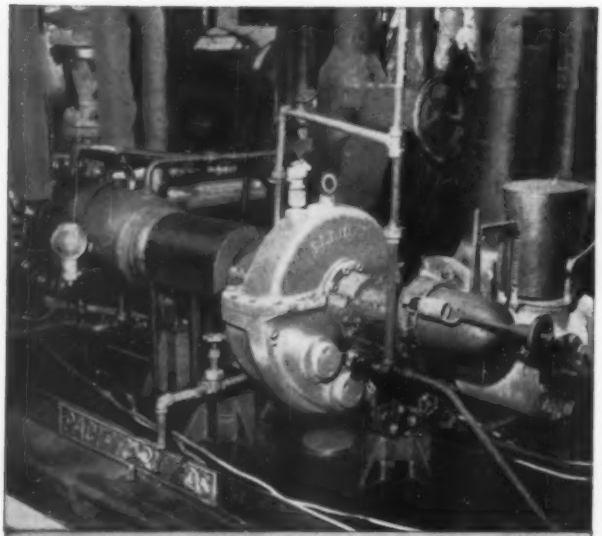


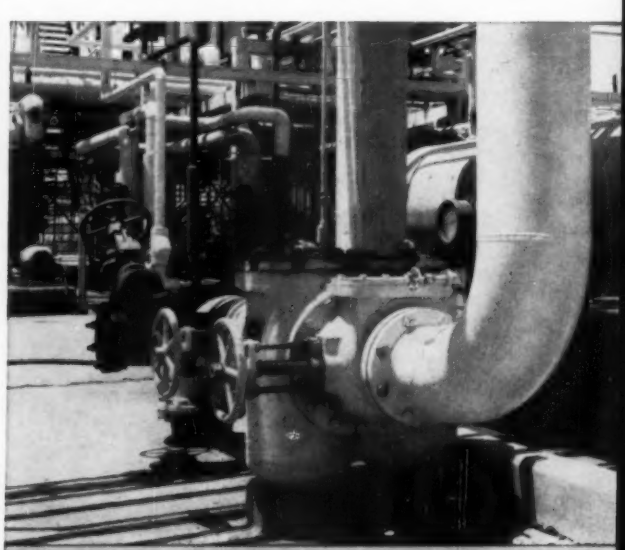
This Elliott 370-hp, 3240-rpm steam turbine drives a reciprocating compressor through a gear. The compressor serves a hydroformer unit.



These two Elliott 450-hp weather-protected outdoor motors, located in the bluff area near the docks, are used to drive centrifugal pumps which handle heavy naphtha from adjacent tankage.



One of eleven Elliott turbines driving centrifugal pumps at a lube oil unit.



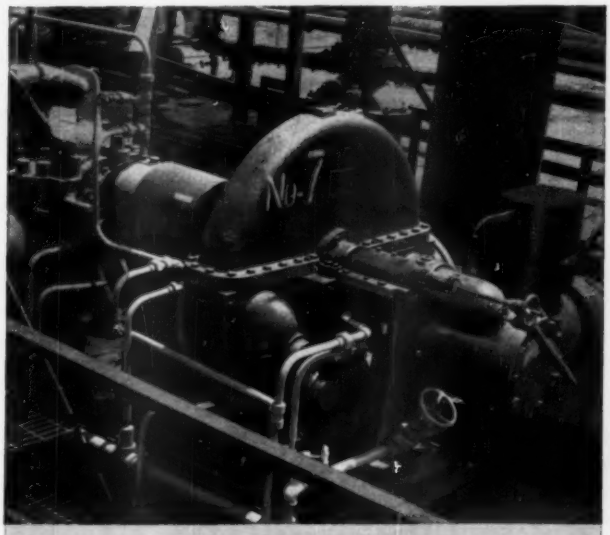
Here an Elliott 8-in. twin strainer handles river water at a lube oil unit.

Esso Standard's Baton Rouge Refinery—producing more products than any other—is served by Elliott Turbines, Motors, Twin Strainers, Steam Ejectors, Deaerating Heaters

When this Esso Standard Oil Company refinery started operations in 1909, it processed 2000 barrels of crude oil per day into only three products. Now it converts 340,000 barrels of crude oil per day into over 600 products—a world's record in respect to number of products. It is also rated the largest refinery in the United States based on crude running capacity.

More than 100 Elliott steam turbines, ranging in size from 7 to 900 hp, are used in this refinery to drive all sorts of pumps, fans and compressors. Over a score of Elliott twin strainers, sizes 2 in. to 24 in., and Elliott steam jet ejectors serving vacuum units have been installed. Elliott 300-hp, 400-hp, and 450-hp motors are driving pumps and an Elliott 1750-hp, 1800-rpm induction motor is driving a centrifugal gas compressor. There are also four Elliott deaerating feedwater heaters.

Here is another dramatic illustration of how highest-quality steam and electrical products, manufactured by Elliott, serve leading industries. For information on how Elliott products can help you, call your nearby Elliott District Office or write Elliott Company, Jeannette, Pa.



***Elliott Turbines,* from small single-stage to large multi-stage types, assure highest-quality, long-term continuous service. This typical installation, operating on a 24-hour-a-day basis, is a 460-hp, 1750-rpm Elliott turbine which drives a river water booster pump. Bulletin H-228 describes the features which have resulted in the widespread use of Elliott YR turbines.**

ELLIOTT Company

Q7-1

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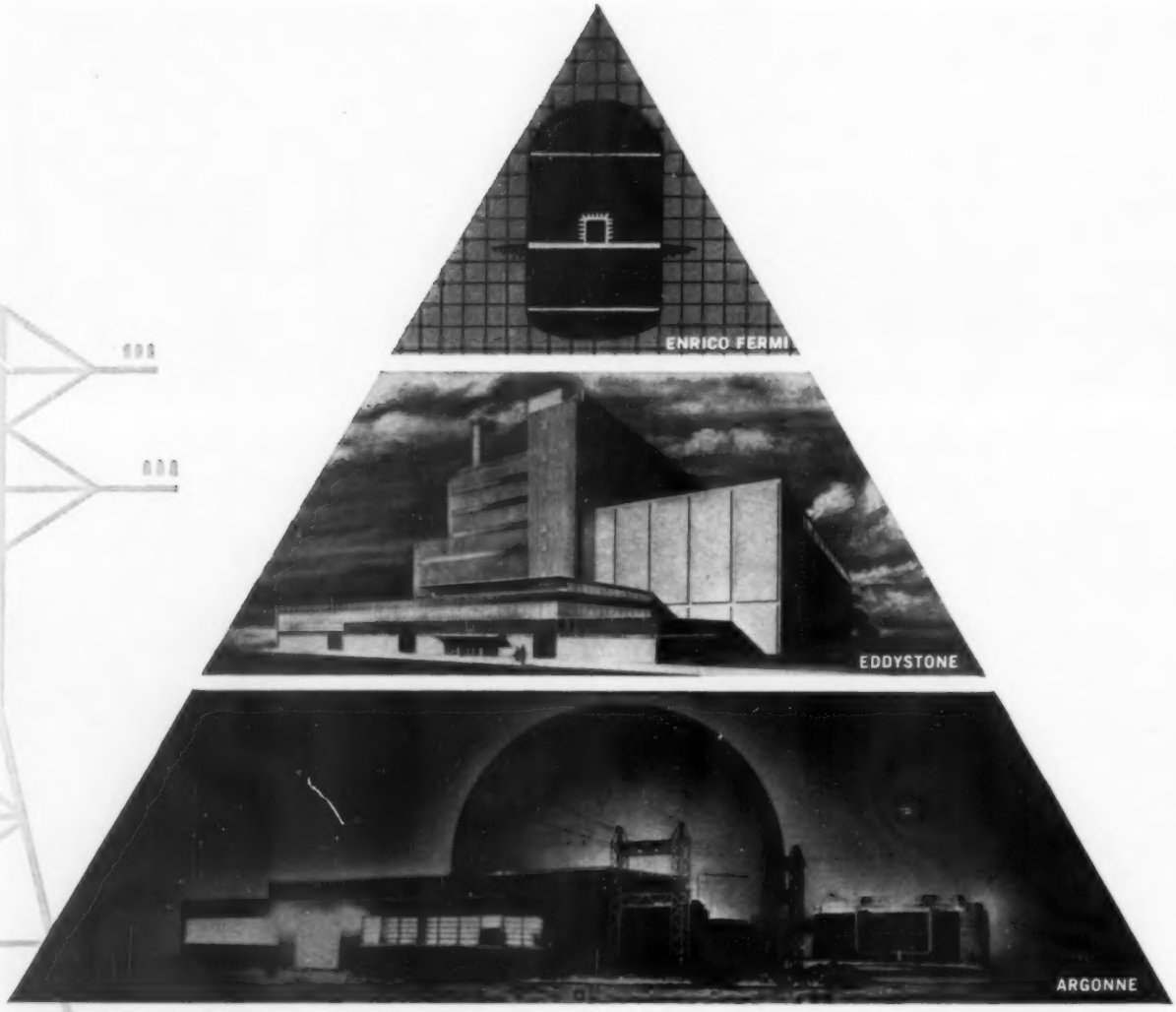

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with advanced water treatment methods and processes

Enrico Fermi Atomic Power Plant. First large-scale fast-breeder reactor in the United States. Built to produce steam for commercial electric power and to advance research. To go into operation in 1960.

Eddystone Station, Philadelphia Electric Company. Largest supercritical plant in the world—highest temperature (1200°F), highest pressure (5000 psig). To go into operation in 1959.

Argonne National Laboratory, the Experimental Boiling Water Reactor. First reactor built to explore the commercial use of atomic energy. Now in operation.

All three installations have in common not only unique water treatment requirements but also the incorporation of scavenger demineralizers. These units were pioneered by Graver Water Conditioning Co. to meet the ultra-pure water requirements of supercritical and nuclear power plants. Now Graver is offering them for use in sub-critical plants where they represent a major breakthrough in problems of internal contamination which are of concern to all power plants.

Our work in boiler feedwater treatment for sub-critical, supercritical and nuclear power plants shows the breadth of Graver's contribution to power progress. Our pioneering of scavenger demineralizers for wide application is but one example of the research and development which goes on constantly at Graver to keep apace of this fast growing industry and to introduce new equipment and methods for the further advancement of the field.

VISIT US AT THE POWER SHOW IN BOOTH 492.

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NBP BPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

LATEST TECHNIQUES in heat control will be featured among the many advanced designs to be shown at the 23rd National Exposition of Power and Mechanical Engineering in the New York Coliseum, December 1 to 5. The exposition runs concurrently with ASME's annual meeting in New York.

Extent to which industrial equipment is being promoted into extreme operating conditions of temperature and pressure is underscored by the incidence of instruments and controls, newly designed or rebuilt, to withstand long ranges between the current extremes of cold and heat, and also to cope with corrosives, explosives and many toxic substances.

Many exhibits will reflect this trend, also showing wide departures from conventional thinking.

Plastic solenoid valves for handling corrosive liquids will be another innovation, while a number of displays will reflect the latest designs for level gages and specialized instrument valving. There will even be a boiler water level indicator which completely avoids the use of glass in its design.

Other exhibits will present a vibration analyzer which permits revolving parts to be balanced dynamically without being dismantled; and solutions for the problem of uninterrupted power supply.

One line of automatic transfer switching equipment cuts in an emergency power circuit when the main source fails, its distinguishing feature being a mechanical holdout. This type of lockout avoids the "a-c hum" of switches that are held on line electrically.

Many displays will present effective solutions for operational problems common to most plants. There will be high- and low-pressure oil burners, parts and accessories, solvents that are said to convert sludge into combustible material, as well as soot-burning chemicals.

A complete line of preventive maintenance testing equipment includes a new 5-kv dielectric test set, a new 6-volt, rectifier-operated insulation tester and a new tachometer.

An excess-flow check snubber contributes to plant safety by preventing the escape of noxious, toxic or flammable liquids or gases in the event of instrument rupture.

Principal focus of the exposition will be on the production and distribution of power in industrial establishments of every description; so many of the exhibits concern the generation and distribution of energy in heat, electricity, gases, compressed air and liquids, as well as motion.

HONORS—ASME's highest award — Honorary Membership — has been awarded for 1958 to John Blizard, director of research for Foster Wheeler Corp; Howard Coonley, professional engineer; James Gleason, chairman of the board of Gleason Works; and Ernest L. Robinson, former structural engineer for General Electric.

Two engineers who specialize in power have also been signaled out by ASME. Frederick P. Fairchild, chief engineer for the Public Service Electric and Gas Co of New Jersey will receive the George Westinghouse Gold Medal. Vivian F. Estcourt, general superintendent of steam generation for the Pacific Gas & Electric Co of California, will be the recipient of the Prime Movers Committee Award for a paper, Plant Management and Other Factors Affecting Maintenance Costs in Steam Generating Stations.

Dr. J. F. Calvert of the University of Pittsburgh has been awarded AIEE's Medal in Electrical Engineering for 1958 "in recognition of his distinguished service as a teacher of electrical engineering."

Francis S. Friel, president of Albright & Friel, Inc, consulting engineers, Philadelphia, has been elected president of ASCE for the coming year.

Arthur Cecil Roe, for 46 years a Westinghouse consulting and design engineer, has joined the engineering department of the National Industrial Service Association.

BY 1990, we may have power plants as big as 16,000,000 kw, predicts Edwin H. Krieg, vice president of Stone & Webster. Krieg was opening speaker at the National Power Conference held in Boston at the end of September, under ASME and AIEE sponsorship (see page 78).

Such a giant, Krieg said, would burn 11,000,000 lb of coal per hr, need a 600-acre site, 10,000,000 to 11,000,000 gpm of cooling water. It would require a major breakthrough in metallurgy, to operate at higher temperatures and pressures, and, of course, turbines, boilers and other equipment will increase in size.

Krieg's opinion is that atomic power will probably become more economical than power generated from coal because coal costs are subject to increased mining and transportation costs, while uranium costs show a tendency to decrease.

SWEDEN'S largest power station, the 375,000-kw Stornorrfors on the Ume River, is nearing completion. First two units will be in operation by the end of this year, the third unit by next May.

Utilizing a head of 246 ft, the Stornorrfors plant is built underground off the river bed proper. Water is conducted to the station through a 1½-mile canal, precipitated through individual tube shafts to each turbine, and discharged to the river through a 2½-mile tunnel.

The three Francis turbines are said to be the largest of their kind in the world. They have a contracted rating of 134,840 kw at 125 rpm each, and a maximum rating of 147,200 kw at a head of 75 meters and a water flow of 200 cu m per second.

Built by the Swedish State Power Board, Stornorrfors has cost $113 per kw.

ADHESIVES as structural joining materials have won acceptance with the American Welding Society. For the first time, the 1959 edition of the Welding Handbook will contain authoritative information on adhesive bonding and the welding of plastics.

5th annual Midwest Welding Conference sponsored by Armour Research Foundation of the Illinois Institute of Technology and the Chicago section of the American Welding Society will be held Jan. 28 and 29 on the IIT campus.

HOME STUDY course of Nuclear Power Plant Operation is being endorsed by the National Association of Power Engineers. Course has been prepared, in 12 lessons, by Steiner Nuclear Services.

JUST PUBLISHED is a newly developed edition of Expansion Joint Standards. Cost is $1 a copy, from Expansion Joint Manufacturers Assn, 53 Park Place, New York 7, N. Y.

Also now available is a new edition of Feedwater Heater Standards, at $2 a copy, from the Feedwater Heater Manufacturers Assn, 53 Park Place, New York 7, N. Y.

R. G. WERDEN, formerly with the York Corp, and well known for his work in refrigeration and air conditioning, has opened his own office in Jenkintown, Penna., as a consulting engineer. Werden is a leading proponent of large, multistage heat pumps for commercial and industrial use.

NUCLEAR PROPULSION for space applications is the latest gleam in the eye of space science. General Dynamics Corp will conduct a series of investigations along this line for the Air Research and Development Command. This study looks to the use of a series of detonations based on controlled nuclear explosions within the atmosphere and beyond. The research will be done at General Atomic's John Jay Hopkins Laboratory for Pure and Applied Science, at San Diego, Cal.

IMPORTANT ANSWERS to questions involved in the $700,000,000 project to harness water for power at Niagara Falls will come out of a model 600 ft long, now being made at Worcester Polytechnic Institute's hydraulic testing lab. Using this model of the new system, the New York State Power Authority can check the effects of the system when flow of water in its projected Lewiston or Tuscarora stations is stopped, started, speeded or slowed.

26 LEADING educational and research institutions have formed an inter-university corporation to be known as Associated Midwest Universities, with headquarters at the Argonne National Laboratory's main site near Lemont, Ill. The new corporation will promote, encourage and conduct research and education in all branches of science, and will establish and operate laboratories. President of AMU is James H. Jensen, provost, Iowa State College.

SMOG budgets for municipalities are getting to be big business. Los Angeles County is spending almost $4,000,000 a year on air pollution control. New York spends about $670,000; San Francisco Bay Area, about $500,000; the California State Department of Health, over $350,000. Industry also is spending large sums on air pollution control. ASME's *Smog News* reports $12,000,000 just for one plant of a large steel company, and sums of around $50,000 are not uncommon.

RAYMOND C. HAGENMILLER, an associate editor of POWER ENGINEERING since 1954, died September 21 following a heart attack. He was 48. Born in New York City, Hagenmiller had been a service manager for the Pitometer Log Corp of New York and during the war years served with the Emerson Electric Mfg Co. in St. Louis. There he developed an editorial group for the production of handbooks and service manuals, and later became assistant service manager.

After the war, he became editorial director for a St. Louis management firm, served as an editorial consultant for the Texas Co, and in 1950 joined the staff of the Applied Physics Laboratory of The Johns Hopkins University, in Silver Spring, Md.

In his work for POWER ENGINEERING, Hagenmiller traveled widely among power engineers, most recently in the task of assembling material for the new booklet, This Is the Power Engineer, which he produced and wrote as a contribution in definition for the power engineering field.

His associates and others will miss his outgoing personality and friendly concern for all with whom he had to do.

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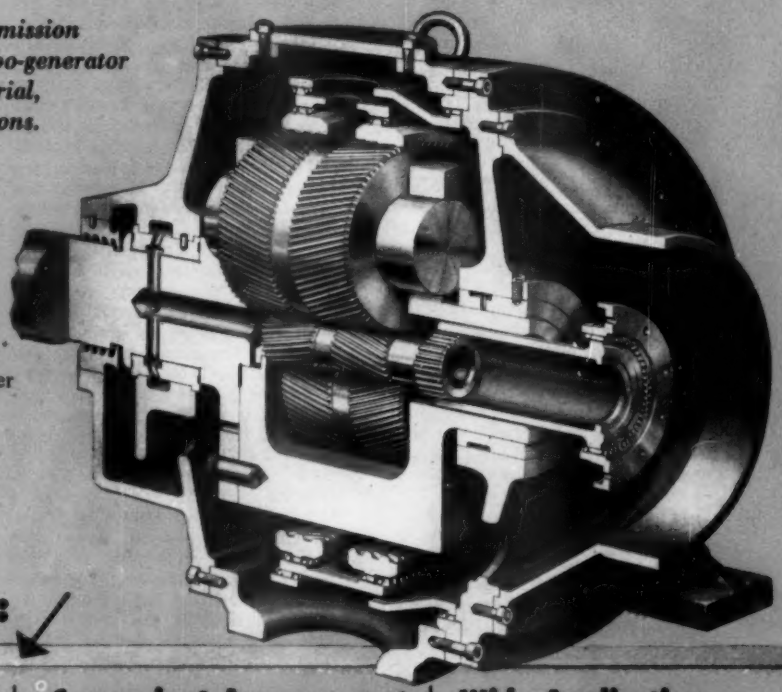
PLANETARY GEAR

...for high speeds...high horsepower

Proved in hundreds of installations abroad totalling over 3,000,000 horsepower—now available in America!

For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.

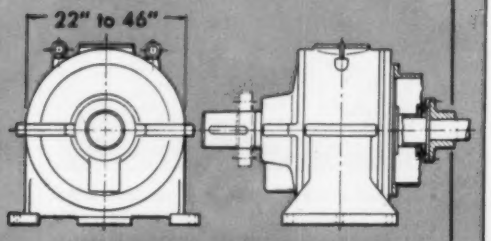
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher)...no high speed bearings...less friction losses.



Check These Advantages:

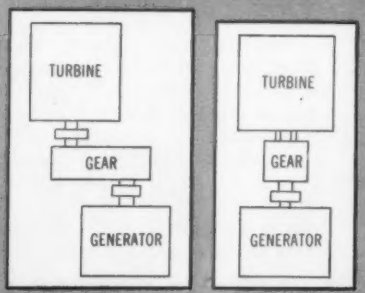
Small Size—Light Weight

Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



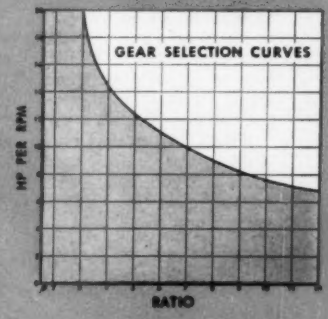
Convenient Arrangement

Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.



Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.



For further details, write for Bulletin 2400.

DE LAVAL *Steam Turbine Company*

816 Nottingham Way, Trenton 2, New Jersey

WHAT THEY TELL US

▶ **MORE** on the fly ash reinjection controversy that has been peppering this department, through A. H. Gesell of Waupun, Wisconsin and M. J. Churchill of the Detroit Stoker Co. Last month, Gesell, who finds fly ash reinjection to be an inefficient procedure, invited Churchill to come to Wisconsin and prove him wrong by testing at Gesell's power plant. Churchill replies:

> Even though your viewpoint and that of our engineers on the subject of fly carbon return are directly opposed, we find your letter very interesting and appreciate your invitation to visit your plant, which we would like very much to do if we should happen to be in that vicinity. It does not appear probable, however, that we will be traveling that way in the near future, and we wonder if we might take advantage of the invitation for one of our service engineers to call on you and inspect your facilities. Such a visit and exchange of ideas might prove beneficial.
>
> We have a man traveling in that area at fairly frequent intervals and your permission to have him call would be appreciated.

▶ **SPECIAL REPORT** by our editor, Chester R. Earle, on the CIGRE meetings in Paris (August issue, pages C1-C12) has drawn the following comment from Lawrence M. Robertson, chief electrical engineer, Electrical Engineering Dept of the Public Service Co of Colorado. Robertson was among the 1700 engineers who attended the Paris meetings.

> I have just received my copy of the August issue of POWER ENGINEERING and have read your report of the CIGRE meetings.
>
> I have read several reports by other people and other publications, but this is the best of them all and I want to take this opportunity to congratulate you on a very good job.
>
> I shouldn't confine my congratulations to the CIGRE article, because I feel that your entire series of articles and magazine are always good and very valuable.

▶ **CREDIT** where credit is due — and expanded information, besides — comes out of contact we've had recently with P. F. H. Towle of the Auto Call Co, Ltd, in London, England. Towle's attention was caught by an article we published in December, 1957, written by F. C. Livingstone and titled, Automatic Warning of Ice on Power Lines. It described equipment installed for the North of Scotland Hydroelectric Board. Towle tells us:

> The transmitter instrument illustrated at the top of the page (86) was designed and manufactured by us.
>
> When Pye Telecommunications Ltd approached us with this problem, we only had the standard machine (Auto Call Tele-Alarm Repeater machine), which is designed for use on telephone lines, being able both to call out and to receive incoming telephone calls. Within ten days we had re-designed the unit, manufactured two of them and delivered them to the factory at Cambridge — which we feel was fast enough to be comparable to the famous American speed of operations.
>
> In its new form, the instrument is set off by the strain gage relay and we switch on vhf heater. After a delay to enable the latter to warm up, we transmit a warning message for 30 sec, then the record stops and power to the radio is turned off. Our instrument, however, continues to time an interval of 30 min, and at the end of that period, if the danger conditions have not been removed, the machine again switches on the radio and gives another 30-sec warning. This procedure is continued until the ice has been melted from the overhead cables. The whole is operated from a 12-v battery.

▶ **PACIFIC GAS & ELECTRIC** is planning to produce electric power from natural steam geysers in northern California near San Francisco. This prospect marks the first American use of geothermal steam for the commercial production of electricity.

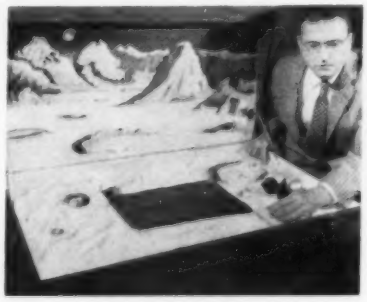
The company plans to build a 12,500-kw generating plant on a hilly slope of Big Sulphur Creek. Steam will be piped to the plant turbine by leaseholders of geyser property on the border of Sonoma and Lake counties. It will be conveyed at 100 psi, 348 F, and 265,000 lb an hour. Comments Norman R. Sutherland, president of the power company:

> While this announcement about geothermal power is of some significance in our industry and probably of general interest to the public, I think it should be borne in mind that this 12,500-kw plant cannot be compared with the average conventional steam plant being built in these times.

▶ **LUNAR POWER STATION,** powered by light from the sun, is an idea in space technology which scientists at Westinghouse have taken seriously. They have even built a working model. A modified vacuum tube containing the same elements that would be used in a full-scale station on the moon, absorbs a beam of light from a nearby sun lamp, generating enough power to drive a small motor.

Dr. Peter Castruccio, head of the company's new Astronautics Institute, explains that:

> . . . the sun at zenith pours upon the lunar surface something like 6000 kw of power per acre, and the proposed lunar power station would use this radiant energy to generate power. Basic components of the power station would consist only of wire mesh and a chemically-coated plastic. Giant sheets of a thin plastic material would be stretched and supported over several acres of the moon's surface. Coated on these sheets would be an extremely thin layer of a photosensitive material.
>
> A thin wire mesh will then be placed parallel to, but slightly separated from the plastic sheet and insulated from it. The photoelectric generator would then be ready to produce electric power.
>
> As the sun's rays strike the plastic sheet, the coated surface will emit electrons. These electrons will strike the wire mesh generating a voltage. Upon closing the circuit between the wire grid and the coated surface through a suitable load, current will then flow.
>
> This type of electric power plant is the lightest known to man, weight of the material amounting to about three lb per kw.
>
> In practice, several cells would be connected in series. This way, practically any voltage, including 110 v d-c, can be obtained.



Demonstration model of moon station

Dr. Castruccio says that insight gained into the photoelectric phenomenon now shows promise of generators having up to 25 per cent efficiency. Achievement of this 25 per cent would mean power yields of about 1500 kw per acre on the moon with the sun at zenith.

Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

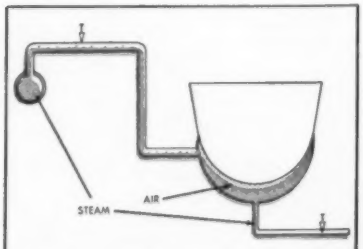


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

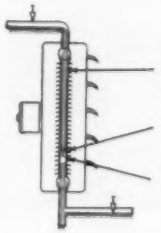


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

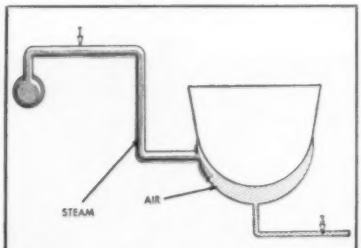


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

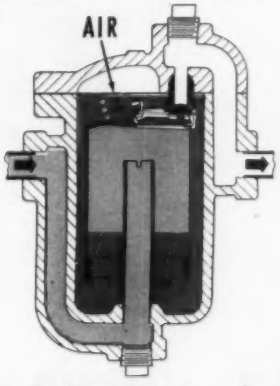
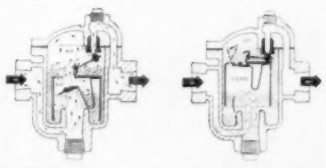


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

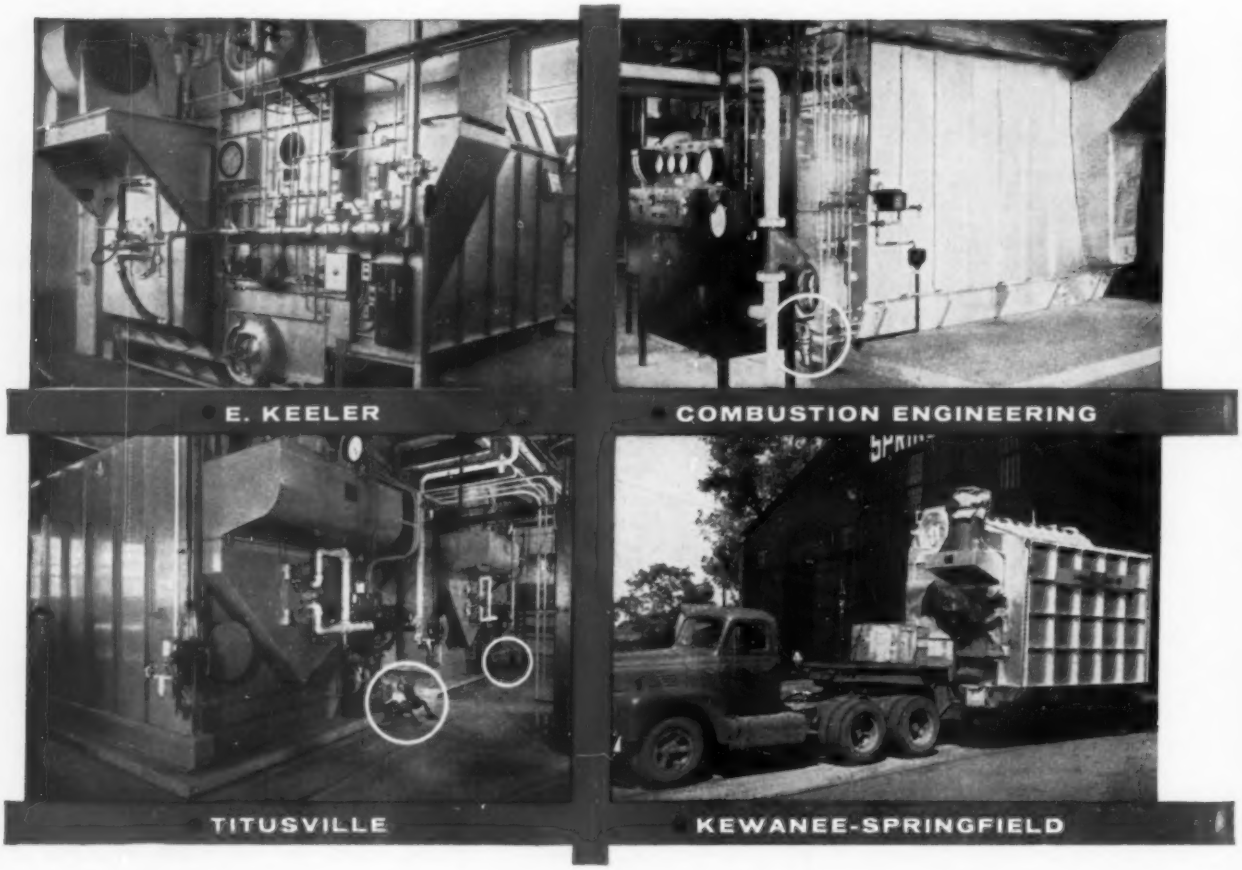
The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8107 Maple Street, Three Rivers, Michigan.

ARMSTRONG STEAM TRAPS

For more data circle 504 on Post Card

the blow-off valve trend on "package" boilers is

YARWAY SEATLESS



YARWAY® BLOW-OFF

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

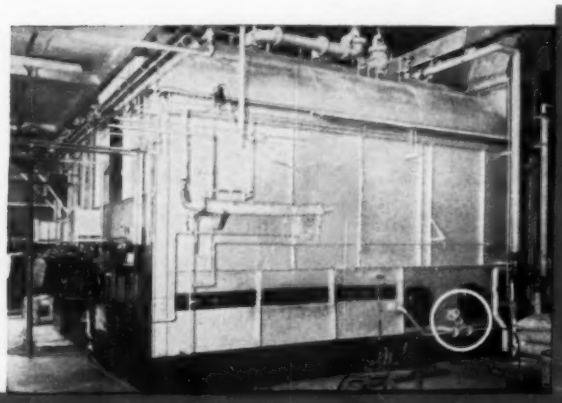
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

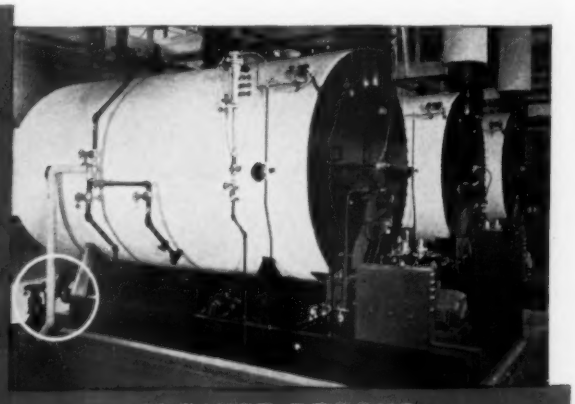
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

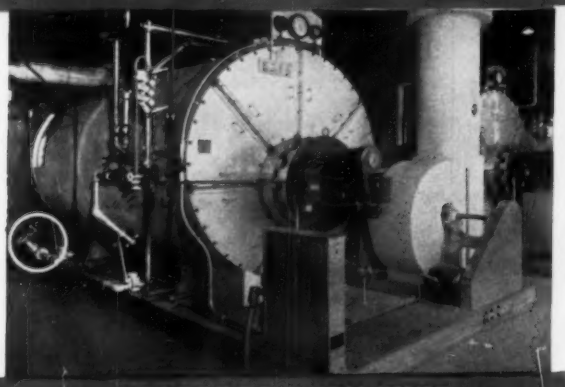
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



● ERIE CITY



● CLEAVER-BROOKS



● PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

For more data circle 505 on Post Card

Specially Designed RILEY Efficiently Fire Multiple Fuels

Inside the Turbo Furnace at Sterlington Steam Electric Station of Louisiana Power and Light Co. Overall width 54'—7⅞", depth 24'—0-3/16". No. 1 firebrick rubble covers the furnace floor. Twenty Riley Directional Flame Burners are arranged for opposed firing on front and rear walls. Burners are shop fabricated assemblies. Burner close-up shows directional vanes, two

The Riley TURBO FURNACE unit is one of the major furnace design advances in recent years for the more efficient utilization of fuels. It is known as a multifuel unit primarily because of its ability to produce similar furnace exit gas temperatures with gas, oil, coal or other solid fuels. This phenomenum is due to the fact that natural gas, which ordinarily burns with a non-luminous flame, burns in a TURBO FURNACE with a luminous flame similar to oil and coal. In a TURBO FURNACE, fuels are burned with extremely high turbulence at the furnace bottom; in the case of pulverized coal, over a slag pool. Much of the unusual combustion efficiency is due to opposed firing with Riley Directional Flame Burners specially designed for firing multiple fuels singly or in combination. These fuels may be pulverized coal, oil, gas, or other special solid fuels such as fluid coke or lignite.

Water Cooled Burner

The Riley Directional Flame Burner is designed for opposed firing on one level. Each Riley Directional Flame Burner is installed as a unit complete with water cooling tubes which are welded to the waterwall circulation system. The waterwall tube arrangement provides maximum cooling of directional vanes, nozzles and other burner parts and reduces to a minimum the possibility of slag adhesion when coal is being burned. No burner refractories are required.

Coal Burning

Two or three burner nozzles per burner are provided when coal or other solid fuels are to be burned. In this way the coal streams are more evenly distributed across the furnace to assure good mixing of fuel and air in the furnace.

Oil Firing

A retractable type oil gun is inserted thru the center slot so as to provide complete mixing of the spray with the air stream. Oil can be burned with either steam or mechanical atomizing equipment.

Gas Firing

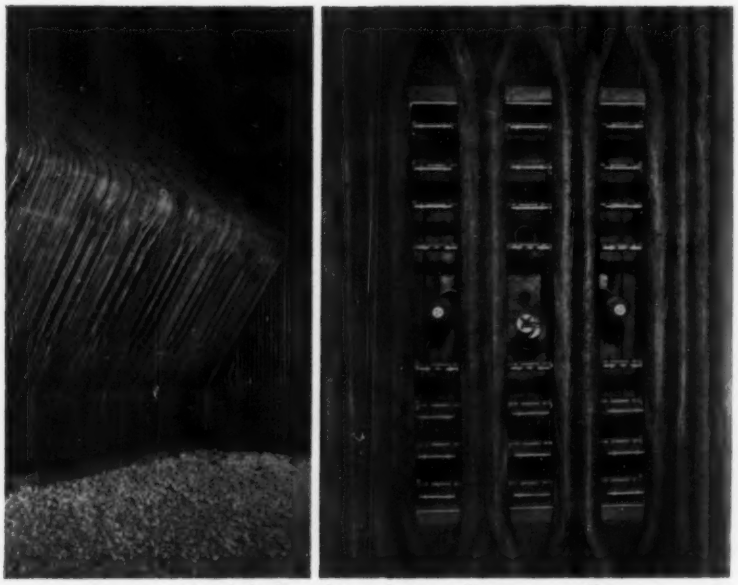
Gas is fired thru guns of high alloy stainless steel. High capacity burners have a gun in each side slot. Gas guns can be installed for mechanical retraction.

A RILEY TURBO FURNACE GIVES YOU THESE MONEY-SAVING ADVANTAGES

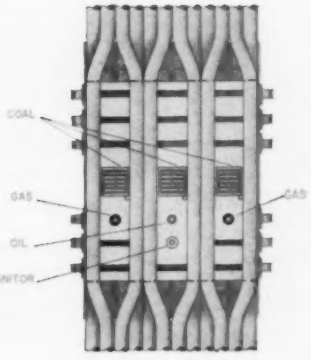
- **The ability to fire multiple fuels: gas, oil and a wide range of solid fuels**
- **A low cost and quick conversion to solid fuels with initial gas/oil firing**
- **Higher heat release with lower overall structure**
- **When firing coal**
  low carbon loss
  clean furnace, no slagging
  elimination of flyash removal with reinjection
- **One level burner operation**

TWENTY THREE RILEY TURBO FURNACE UNITS HAVE BEEN SOLD SINCE ITS INTRODUCTION IN LATE 1954!

Directional Flame Burners in a RILEY TURBO FURNACE



gas guns, gas electric ignitor, observation port. Burner can easily be converted to oil and coal firing.



RILEY
DIRECTIONAL FLAME BURNER
Pulverized Coal, Oil and Gas

Directional Vanes

Each slot is provided with directional vanes to project secondary air into the furnace so as to secure the desired placement of flame for most effective combustion. The vanes above the burner centerline and those below each have separate controls. Vanes are made of high heat resisting alloy.

Burner Shut-Off

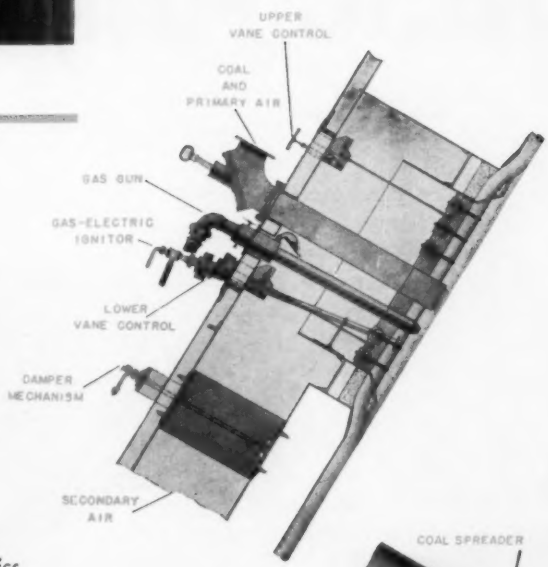
Each burner has a separate secondary air shut-off damper which can be locally or remotely controlled.

Riley Gas-Electric Ignitors

Riley Gas-Electric Ignitors are available with Riley Directional Flame Burners.

Pressurized and Non-Pressurized Operation

Riley Directional Flame Burners are designed so that they can be used either with pressurized or non-pressurized furnaces.

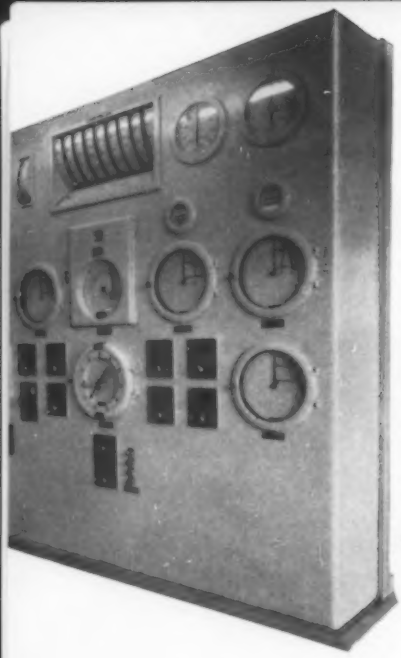


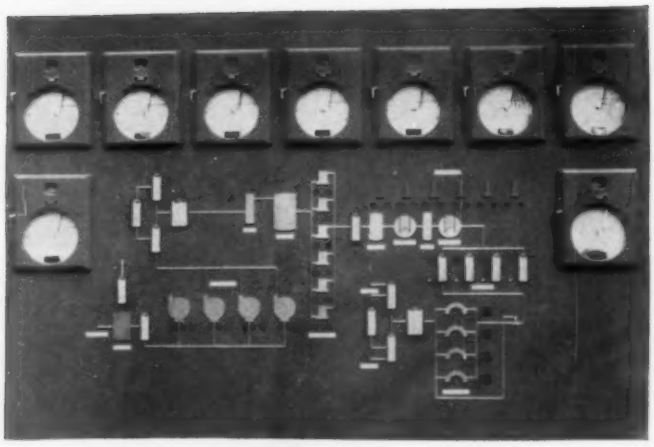
The complete story about the unusual operating characteristics of the Riley TURBO FURNACE and DIRECTIONAL FLAME BURNERS can be obtained by writing RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS or contacting a Riley representative in any one of these cities:

Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

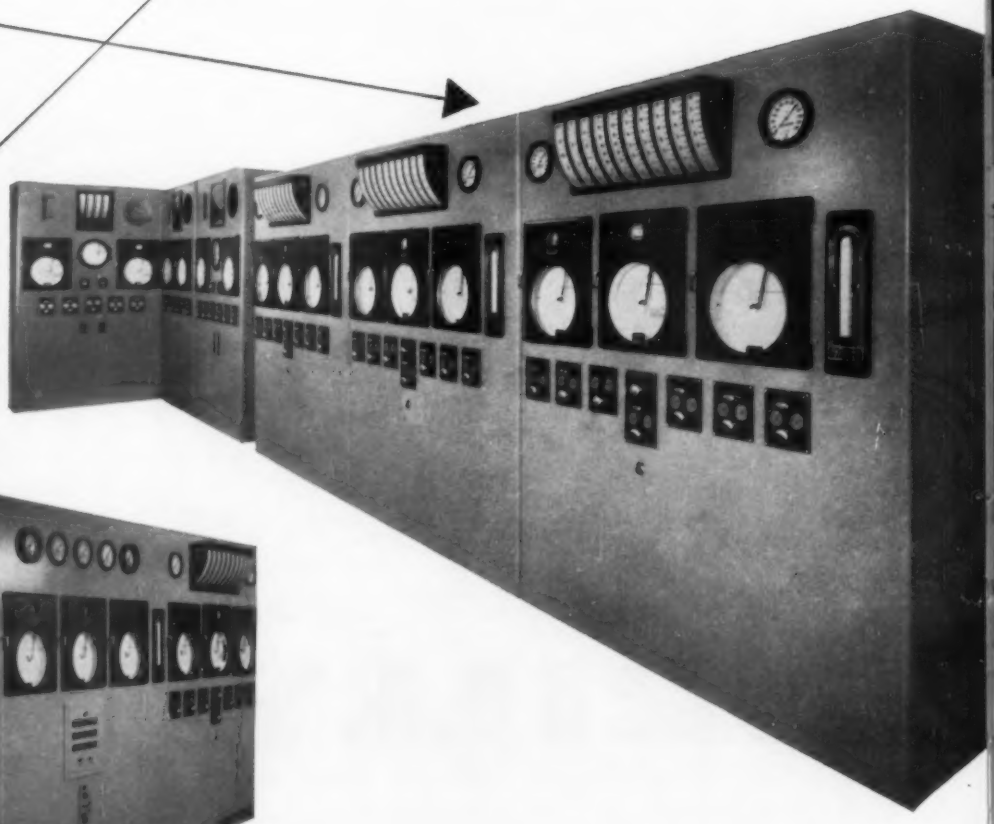
RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

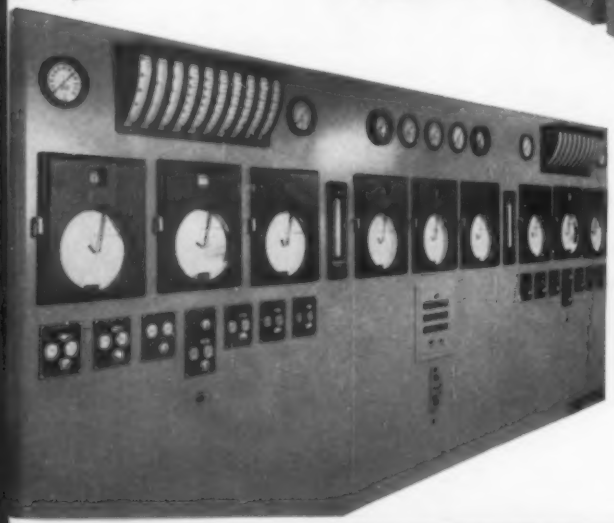
For more data circle 506 on Post Card

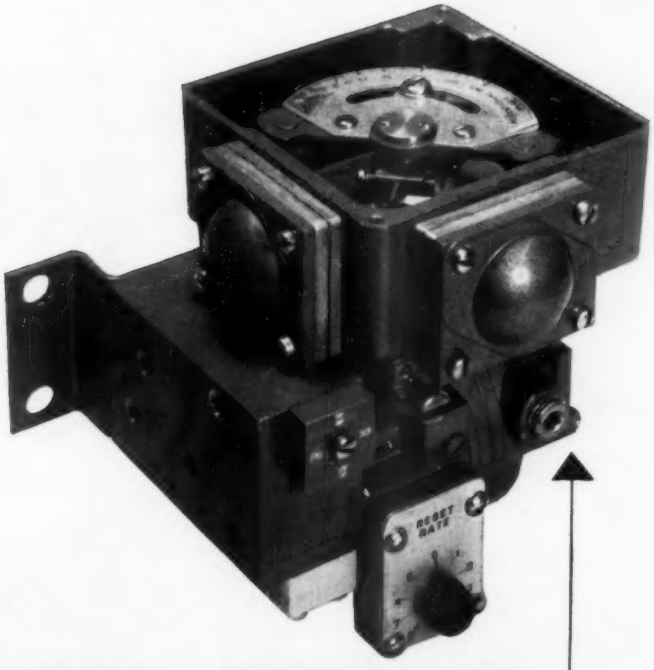




Base Any Of These....







.....ON THIS

For accurate, efficient, dependable control systems– new Rockwell-Built REPUBLIC TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts*, for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action. Local or remote pneumatic set point optional.

Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Sales offices in principal cities throughout the U.S. and Canada. Write to Republic Flow Meters Company (subsidiary of Rockwell Manufacturing Company), 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS

more fine products by

ROCKWELL

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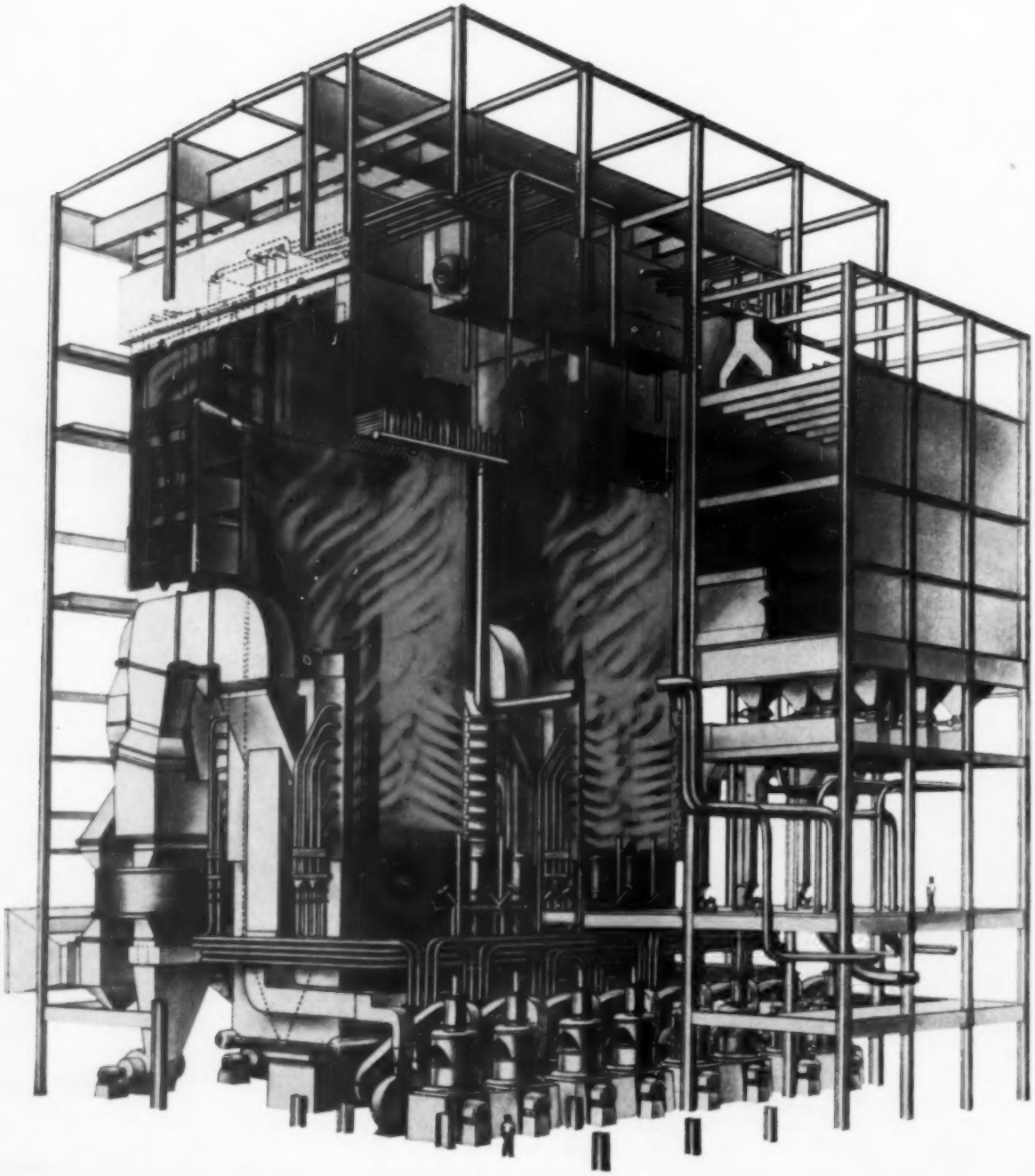
C-E earns an in the 2400 psi



C-E CONTROLLED CIRCULATION TWIN-FURNACE BOILER

Controlled circulation units of the twin or divided furnace type have amply demonstrated their suitability for high-pressure, high-capacity requirements.

overwhelming preference throttle pressure range

Recent years have seen a marked trend toward the use of the 2400-lb *throttle* pressure, and indications are that this will be the prevailing pressure for units in the 200 MW-up class for some time to come.

The following list of C-E Boilers installed, under construction or on order, reveals the *extent of Combustion's experience* in the design, manufacture and operation of 2400-lb boilers. The total electric generating capacity of these boilers (6,592,000 kw) accounts for well over half of *all* the 2400-lb capacity ordered to date by American utilities.

Another significant aspect of present American practice in this pressure area is the recognition of the C-E Controlled Circulation Boiler as *the design best suited to use of the 2400-lb cycle.* The extent of this recognition may be judged from the fact that 30 of the 33 units listed are of this design. The other 3 are C-E Sulzer Monotube Steam Generators.

C-E Boilers* for 2400-lb Throttle Pressure

COMPANY	STATION	NO. OF UNITS	STEAM TEMP. F	CAPACITY—kw TOTAL
Central Hudson Gas & Electric Corp.	Danskammer	2	1050/1000	250,000
Cincinnati Gas & Electric Co.	Beckjord	1	1055/1005	156,250
Cincinnati Gas & Electric Co.	Miamifort	1	1055/1005	156,250
Cleveland Electric Illuminating Co.	Eastlake	1	1050/1050	187,500
Cleveland Electric Illuminating Co.	Ashtabula	1	1050/1050	225,000
Consumers Power Co.	Dan E. Karn	1	1050/1050	250,000
Consumers Power Co.	Port Sheldon	2	1050/1000	500,000
Dayton Power & Light Co.	Tait	2	1050/1000	260,000
Detroit Edison Co.	St. Clair	1	1050/1000	325,000
Duke Power Co.	Allen	2	1050/1000	330,000
Duke Power Co.	Allen	2	1050/1000	550,000
Duke Power Co.	Lee	1	1050/1000	165,000
Metropolitan Edison Co.	Portland	1	1050/1050	165,000
Niagara Mohawk Power Corp.	Huntley	2	1050/1000	400,000
Niagara Mohawk Power Corp.	Dunkirk	2	1050/1000	400,000
Pennsylvania Electric Co.	Shawville	2	1050/1000	330,000
Pennsylvania Power & Light Co.	Brunner Island	1	1005/1005	300,000
Philadelphia Electric Co.	Schuylkill	1	1050/1000	175,000
Potomac Electric Power Co.	Dickerson	2	1050/1000	350,000
South Carolina Electric & Gas Co.	McMeekin	2	1050/1000	250,000
Tennessee Valley Authority	Widows Creek	1	1053/1003	500,000
Virginia Electric & Power Co.	Chesterfield	1	1000/1000	167,000
Virginia Electric & Power Co.	Possum Point	1	1000/1000	200,000

*The above list covers American utilities only. Abroad, too, the C-E Controlled Circulation Boiler has achieved a predominant position for 2400-lb applications, evidenced by orders placed with C-E or its licensees for 21 units with an aggregate capacity of 5,270,000 kw.

COMBUSTION ENGINEERING

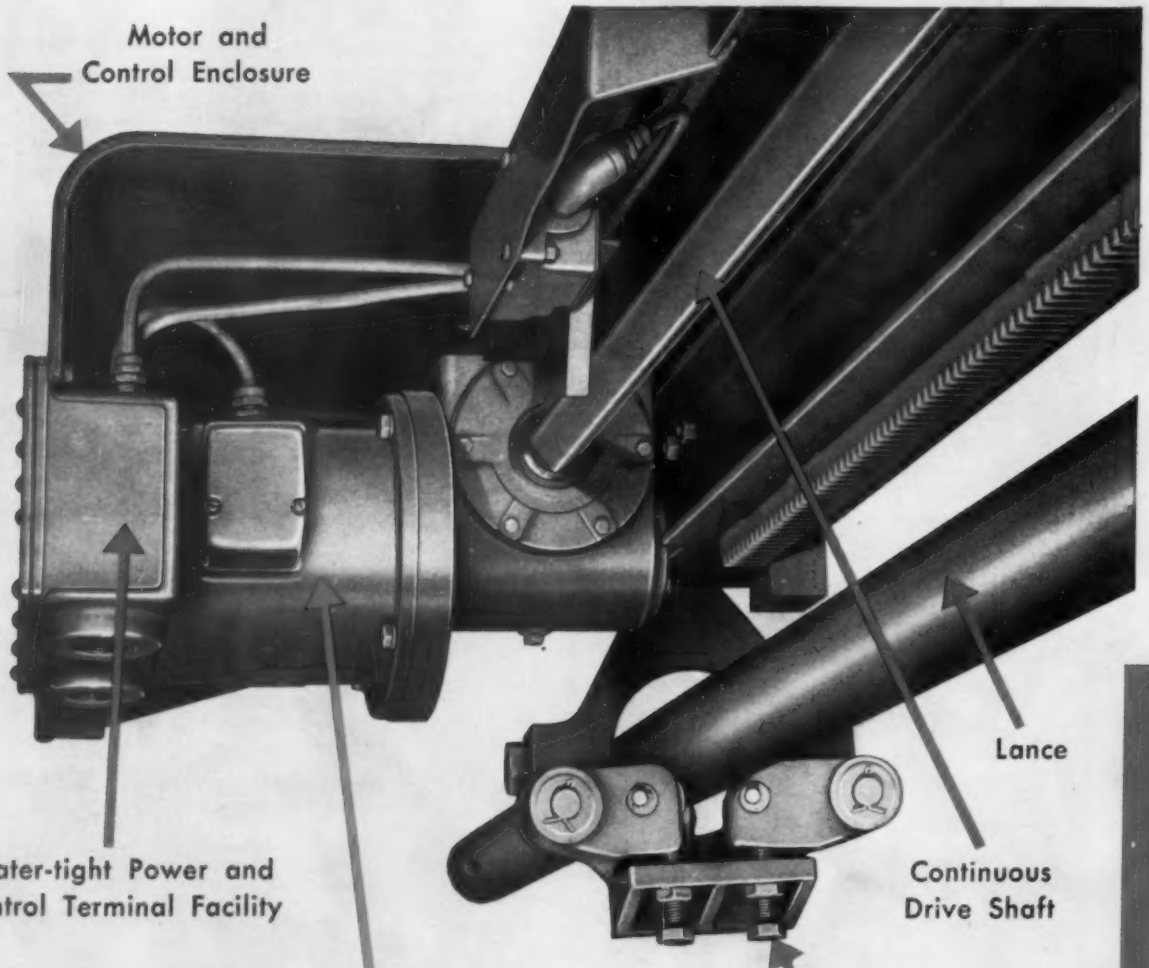
C-181

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 508 on Post Card

FRONT END



Single Enclosed Motor for both
propulsion and rotation
Motor mounted at boiler end for improved
accessibility and better protection from
physical damage and elements.
(Outboard end motor mounting optional)

Single-Motor DRIVE

another important feature of

New Diamond

Series 300 IK
LONG RETRACTING BLOWER

As illustrated at the left, only *one motor* is used to simultaneously propel and rotate the lance tube of the new Series 300 IK. The motor is stationary and is mounted at the boiler wall for easier accessibility and greater protection from physical damage and the elements (note the protective enclosure). This front end single-motor drive is simple and dependable. There is only *one* set of motor elements . . . *one* set of control elements . . . and one set of power supply facilities to operate and maintain.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask your local Diamond office or write directly to Lancaster for Bulletin 2111AB.

SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

Diamond

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited

Windsor, Ontario

8083

For more data circle 509 on Post Card

Turbines operate closer to maximum efficiency with

Hagan Steam Temperature Control

The closer turbines can operate to their maximum design temperature, the more efficient their operation. Hagan's steam temperature control system permits a closer approach to this optimum figure through extremely sensitive temperature measurement and the maintenance of very stable control despite narrow proportional band settings.

The chart shown is from Commonwealth Edison's Will County Station, and is typical of the results produced by this Hagan system. Utilizing Hagan's PowrAmp for amplification, the system is sensitive to temperature changes of 1°F or less. Ratio Totalizers are employed for derivative action, as controllers and for signal combining. For example, the system includes a signal from steam flow so that load changes can be anticipated.

Valves and dampers are operated by Hagan Power Positioners, which provide the necessary power, accuracy and speed to keep up with the rest of the system. The use of a suppressed scale enables the system to maintain closer control, and the high stability of the system permits fully automatic control, even under fluctuating loads.

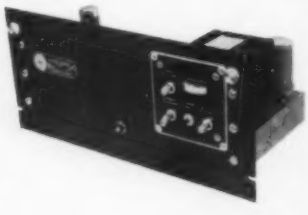
Hagan steam temperature control systems are in use on all types of boilers. Temperature control is achieved by flue gas recirculation, by various types of attemperation, by split firing, by burner tilt or by a combination of these methods. Temperature sensing and amplification may be either pneumatic or electronic, as shown below.

A Hagan engineer would be glad to explain exactly how a Hagan system can add to production efficiency. Write or phone Hagan at the address below, or the Hagan office nearest you.

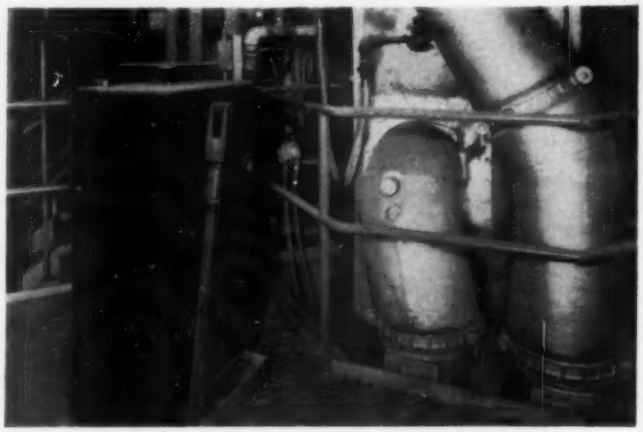
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY • HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

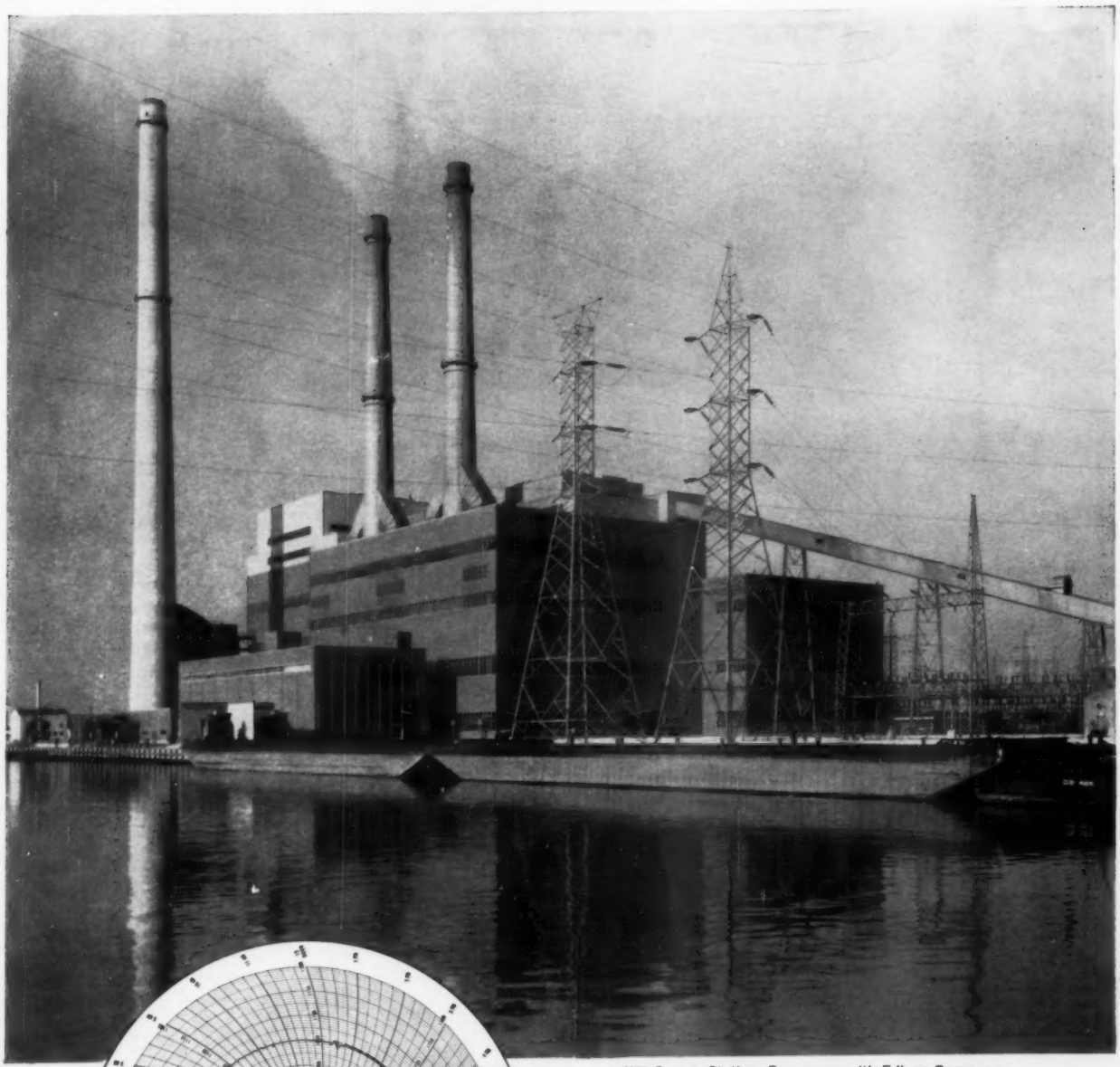
Hagan PowrAmp Amplifier is used with thermocouples for high speed response and ± 0.25% accuracy. Sensitive to very small temperature changes, PowrAmp equipment has a high degree of stability, and permits very close approach to optimum operating temperatures.



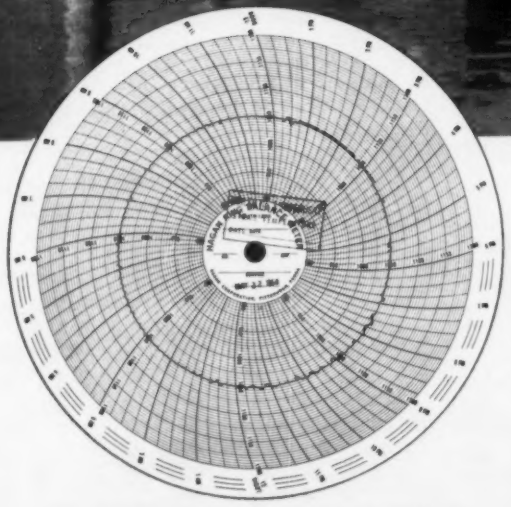
Hagan Pneumatic Thermostat provides practically instantaneous response to temperature changes and a high degree of accuracy. Generating a pneumatic output signal, it is suitable for measuring and controlling temperatures up to 1200°F at static pressures up to 2400 psig.



Hagan 8 x 14 Power Positioner controlling burner tilt. Precise and rapid response to control signals provides maximum possible regulation of superheat temperatures, reducing need for attemperation.



Will County Station, Commonwealth Edison Company, has Hagan Steam Temperature Control on Unit No. 3.

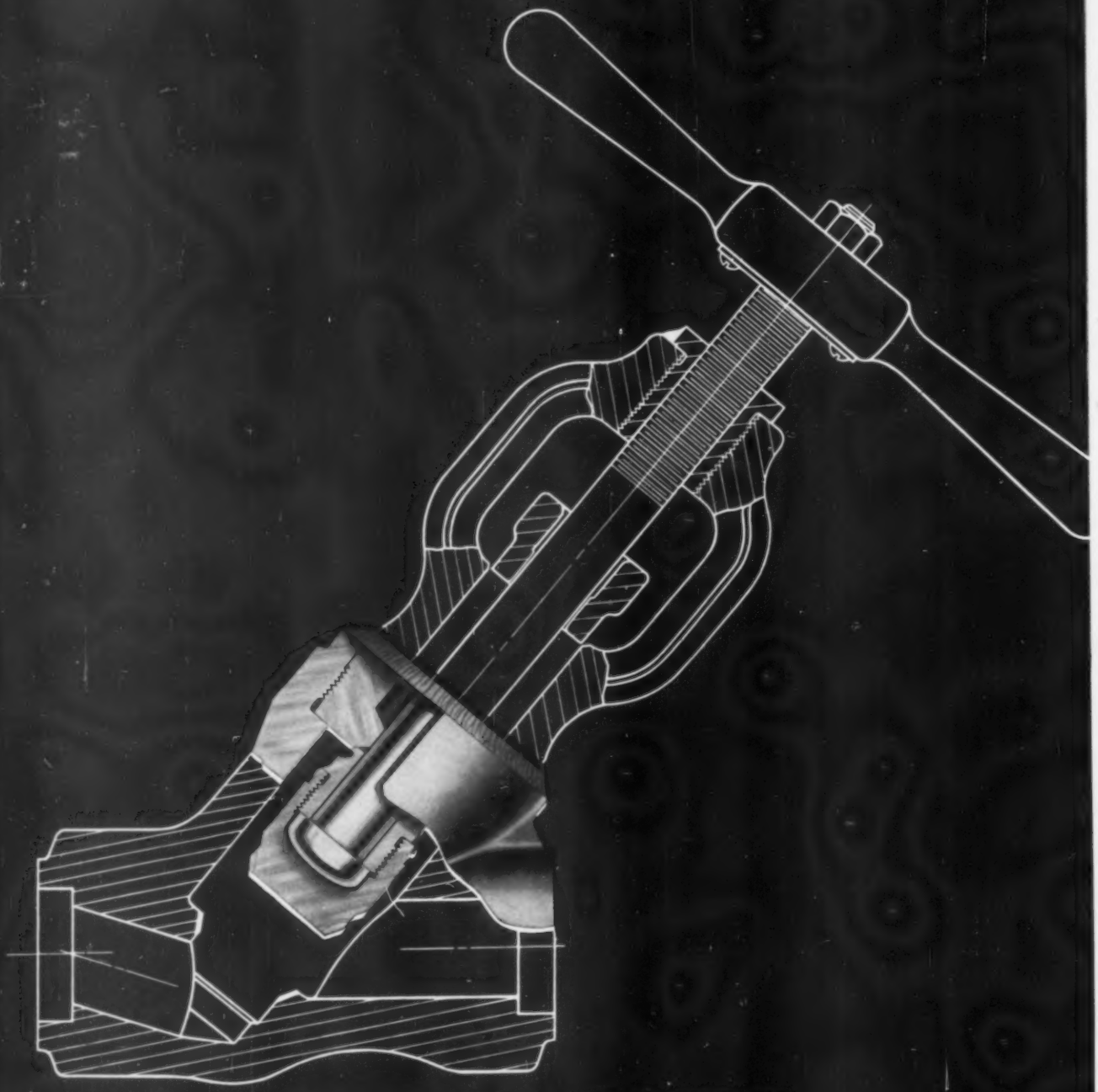


Typical superheat steam temperature chart with Hagan control. Note that chart range is 900° to 1200°, so that maximum swing recorded is approximately 5°

These are some of the Electric Utilities who have purchased Hagan Steam Temperature control systems for one or more units:

Arkansas Power & Light Company
Carolina Power & Light Company
Commonwealth Edison Company
Consolidated Edison Company of New York, Inc.
Detroit Edison Company
Duquesne Light Company
Missouri Public Service Company
Montaup Electric Company
Niagara Mohawk Power Corporation
Orlando Utilities Commission
Tampa Electric Company
Texas Power & Light Company

For more data circle 510 on Post Card



EDWARD UNIVALVE

What's New from Edward Valves, Inc.

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Shoulder, thread and weld make

Superior "Univalve" Body-Bonnet Joint

Edward valve researchers were assigned three main goals in developing the Univalve* . . . first, design a globe valve for high pressure-temperature service—that would *stay* leak-proof . . . second, eliminate—as far as possible—the necessity for maintenance . . . third, fabricate all pressure-containing parts of forged steel for maximum strength and soundness.

How well they succeeded is illustrated by this fact: in many hundreds of advanced temperature-pressure applications all over the world, Edward Univalves have given consistently superior service. The *reason* for this is simple . . . Univalves, properly maintained, simply do not leak.

WELD SEALS JOINT

In the Univalve, a bead of fine-grained weld seals the body-bonnet joint to maintain perfect pressure tightness in any service. A guiding section above the threads protects them from the seal-weld; the threaded section and body shoulder carry the pressure load and insure accurate alignment. The rugged threaded bonnet—with opening just large enough to accommodate the stem—provides a pressure-tight backseat. The radiused disk nut contacts the beveled bonnet backseating surface . . . isolates packing from line pressures and temperatures . . . stretches packing life.

While the Univalve rarely needs attention, even its tough integral Stellite seating surface *can* become scored under some conditions. To strip for inspection and possible re-lapping, the seal-weld is easily removed by machining or grinding or with carbon arc or oxy-acetylene scarfing tip. Besides simple disassembly and positive backseat advantages, Univalve's one-piece gland eliminates possible small parts loss during repacking.

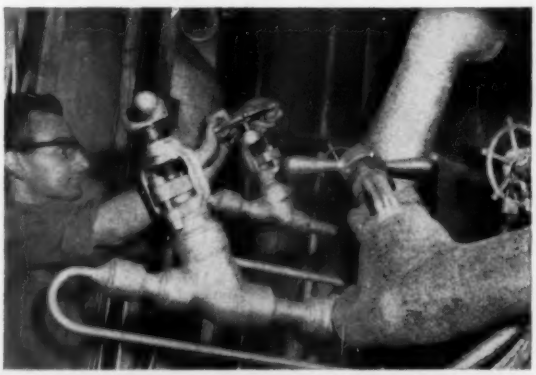
IMPORTANT UNIVALVE FEATURES:

Streamlined Flow Path reduces pressure drop, minimizes wear-producing turbulence. Univalve meets requirements for blow-off service.

Simple Packing Adjustment keeps packing maintenance down. Sturdy gland bolts, roomy yoke, one-piece forged gland.

Easy Open—Tight Close Operation of all Univalves 1¼" to 2½" made a reality with the exclusive Edward Impactor* handle.

Continuous Stellite Ring applied to body and disk, retains hardness under temperature and resists wear.



4500 LB UNIVALVE in service at Ohio Power Company's supercritical Philo station.

*T.M. Reg. U.S. Pat. Off.

IDEAL FOR BLOW-OFF SERVICE. Univalves meet ASME Code for blow-off service and are adaptable for all high pressure installations.

EDWARD VALVES, INC.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1202 West 145th Street, East Chicago, Indiana

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 7500 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

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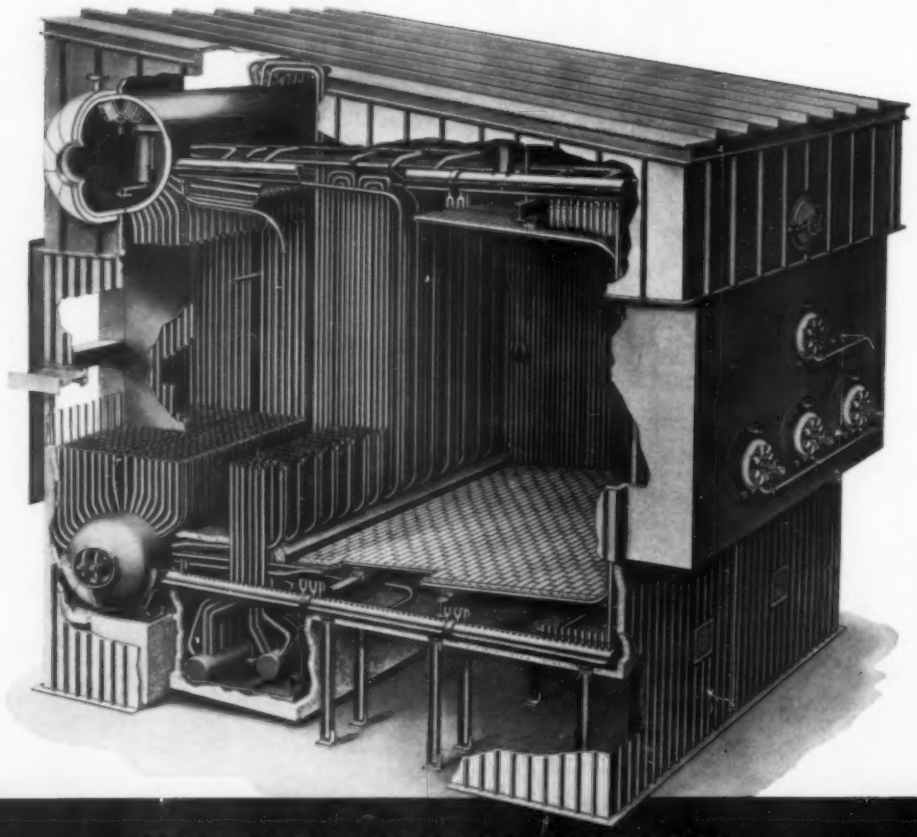
Designed For Tomorrow's New, Economical



HERE ARE 8 WAYS IN WHICH THE PFI BOILER CAN BE OF BENEFIT TO YOU:

1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators ensure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-welded Membrane Wall contributes to high efficiency and reduces insulation requirements.

Plants
Power For Industry

New B&W
PFI Oil-Gas Burning Unit Provides Maximum Output in Minimum Space

Here's an answer to industry's need for an economical, dependable steam supply. The new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, the "Power for Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. The new boiler gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

All responsibility for your complete delivered and erected unit is accepted by one experienced, dependable source which in the past 25 years alone has placed over 4,000 Integral-Furnace Boilers in service. Behind *every* B&W Boiler is nearly a century of leadership in steam generation. A national network of B&W plants and engineering facilities means that the special skills of B&W engineers are always quickly available to you for service and assistance. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

For further information about the B&W PFI Boiler, write for Bulletin G-94.

BABCOCK & WILCOX

BOILER DIVISION

G-899

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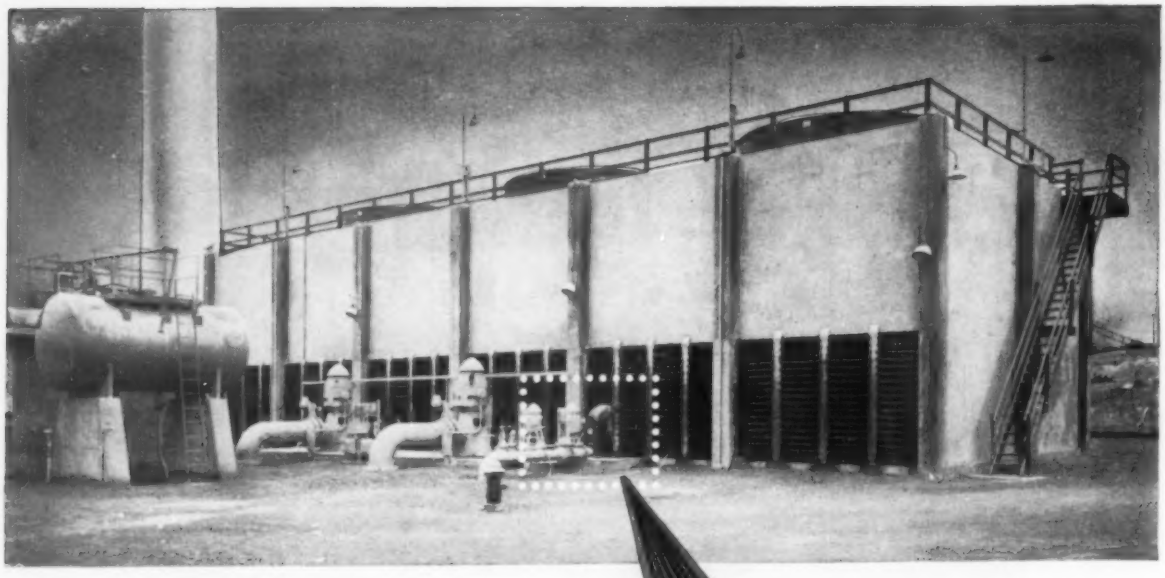
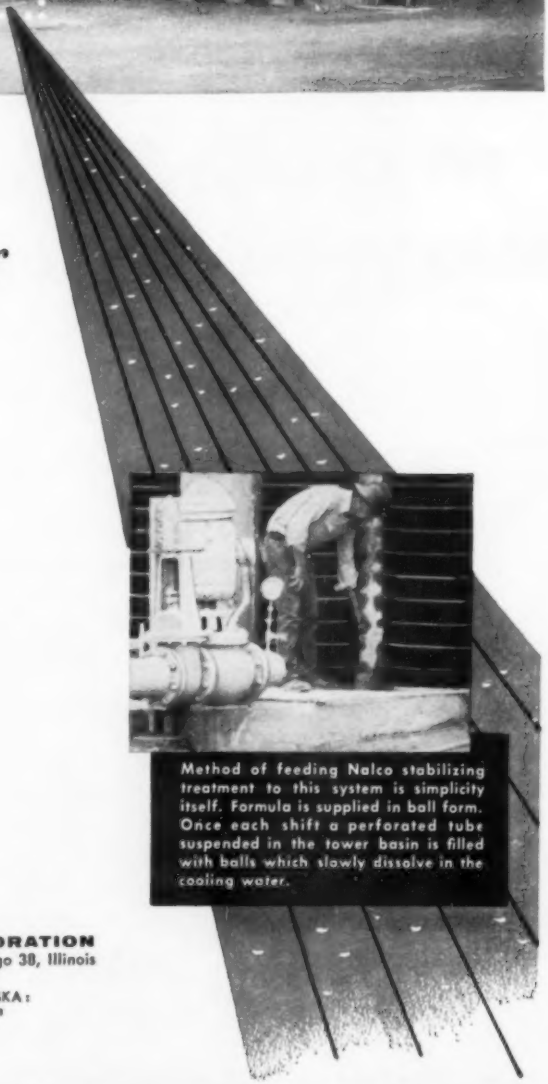


Unusual Cooling Tower

gets proven *Nalco* protection

This unusual cooling tower was built for the Riverside Cement Company at Oro Grande, California. The advanced design provides for concrete exterior walls which support and enclose fan units and redwood interior cooling vanes . . . The entire "working sections" of the tower can be repaired or replaced without affecting the structural strength of the shell. Nalco System Treatment protects this cooling system against scale and corrosion — has protected it effectively since it was first put in operation over two years ago. You can get the same complete water treatment protection, promptly, from Nalco. Write for details.



Method of feeding Nalco stabilizing treatment to this system is simplicity itself. Formula is supplied in ball form. Once each shift a perforated tube suspended in the tower basin is filled with balls which slowly dissolve in the cooling water.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH
SPAIN: Nalco Espanola, S.A.

THE *Nalco*® SYSTEM ... SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

For more data circle 513 on Post Card

HELPFUL BULLETINS

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 105 and 106.

PIPING AND TUBING

101 PVC Pipe Manual — Sixteen-pp Bulletin PVC-100 discusses selection and application of company's polyvinyl chloride pipe, tubing and fittings. Illustrated with photos, charts and tables, it covers both normal and high-impact PVC. Includes comparative costs of PVC and metal piping; mechanical, thermal and electrical properties; pipe and tubing specifications; and fitting types. Also included are tables of corrosion resistance, charts of working pressure and tensile strength vs temperature; charts of thermal expansion and of head loss vs flow rate; recommended support spacing. Carlon Products Corp.

102 Pipe and Tubing — Bulletin 20, 16 pp, on Fibercast chemical and line pipe, tubing and fittings, is an engineering data and information booklet. Provides pipe strengths, chemical resistance, specifications, installation procedures and application information. Bulletin is generously illustrated. Fibercast Co.

103 Stainless Steel Tubing — Bulletin TB-415 explains how welded stainless steel heat exchanger and condenser tubes are made, and also points out fabrication and service advantages of using fully annealed tubing. Tubular Products Div., The Babcock & Wilcox Co.

PUMPS, COMPRESSORS

104 Reciprocating Pumps — Described in 8-pp Bulletin 758 are three types of reciprocating pumps for chemical proportioning and power service, capacities from 2 cc per hour to 675 gph. Forty-two standard sizes are tabulated with pressure and horsepower data. Describes Purgeport feature of these pumps which permits cleaning without breaking piping, bleeding air from pump, showing pumping action etc. Jaeco Pump Co.

105 Sump Pump Guide — Sixteen-pp Bulletin 4500-B, on sump pumps, emphasizes construction advantages of heavy-duty sump pumps in the line; outlines various guide bearing assemblies available for the larger line of pumps; introduces new vertical dry pit and immersion process pumps, others. Provides ordering and installation data, ratings, dimensions, information on control equipment. Illustrated, and includes prices. The Deming Co.

106 Gas Pumps — Rotary positive gas pumps available in 18 sizes are covered in 6-pp Bulletin XA-458. Technical rating data is presented along with design and construction data to aid in selection and application. Roots-Connersville Blower, Div., Dresser Industries, Inc.

107 Rotary Blowers and Pumps — Full details on continuous-service rotary positive pressure blowers, gas and vacuum pumps are included in 20-pp Bulletin S65C. Contains photos and cutaway drawings showing construction features, as well as explanation of operating principles, typical applications. Sutorbilt Corp.

108 Low Pressure Compressors — Eight-pp Bulletin A-95 describes a line of low pressure compressors for heavy duty industrial applications. Engineering design features are detailed and advantages explained. Joy Mfg. Co.

109 Centrifugal Compressors — Twenty-pp Bulletin 909 describes construction and operating features of centrifugal compressors; lists typical applications. Ratings are tabulated for typical pressure-volume-horsepower selections. Arrangements possible are illustrated, as are design features. Impeller balancing and test procedures are discussed. Also covered are bearing pedestal design and lubrication system, and a section is devoted to compressor controls. American Blower Div., American-Standard.

INSTRUMENTS AND CONTROLS

110 Automatic Controls — Catalog 26 comprises 52 pages which describe and illustrate electric thermostats, pressure controls, humidistats, motor-operated valves, temperature regulators, motor operators, unit ventilator controls, hot water controls, electronic controls, control centers and accessories. Operational and application data is incorporated with the description of each control component. Barber-Colman Co.

111 Liquid Level Gages — Condensed Catalog 335 contains 8 pp of information on standard and special function gages and valves. Illustrated with photos and drawings, it includes dimensional drawings, construction features, pressure-temperature graphs and ratings, materials, tables of sizes, specifications and features. Jerguson Gage & Valve Co.

112 Process Instrumentation — Representative process instrumentation and equipment are described in 8-pp Bulletin 100-R5. Contains photos, operational data, and design feature descriptions of twelve varied products for positive control of materials in motion, including flow tubes, telemetering, supervisory control, butterfly valve, valve positioners, others. Builders-Providence, Inc., Div. B-I-F Industries, Inc.

113 Valve-Regulator Manual — Installation, operation and maintenance instructions for company's valve-regulators are given in 16-pp Bulletin 1099. These pneumatically controlled, cylinder operated, lubricated plug valve regulators are designed to provide high-pressure large-volume gas regulation with minimum pressure loss. Typical installations, mounting and piping arrangements are illustrated. Sections of the book cover typical operational problems, how to check troubles, orifice and nozzle cleaning other details. Rockwell Mfg. Co.

114 Guide to Manometers — Catalog 2008, 24 pp, presents manometers for measuring pressure and vacuum. Covers U-type, well-type (single- and multi-tube) and inclined-tube manometers, manometer indicating liquids, and accessory equipment. Product descriptions and specifications are given. Also provided are details on operation, selection tips. King Engineering Corp.

115 Double Duct Control — Catalog F-8753 describes a double duct mixing unit with self-contained constant volume control which delivers constant cfm while mixing hot and cold high velocity air and reducing it to conventional velocities at a minimum noise level. Engineering data, dimensional and application information included. Barber-Colman Co.

116 Feedwater Regulator — Bulletin 1055, on the Flowmatic Type P feedwater regulator, gives mechanical description of components and schematic diagram showing suggested piping arrangement. This two-element air-operated feedwater control is responsive to both drum level and steam flow. A table lists design features, materials of construction and application pressures. Copes-Vulcan Div., Blaw-Knox Co.

117 Photoelectric Systems — This 24-pp illustrated brochure contains detailed specifications, descriptive data, operational charts and a concise selector guide for photoelectric systems for control applications. These include long range protection against intrusion, counting, sorting, inspecting, precision registration and high-temperature measurement. Also described are miniature and sub-miniature photoelectric receivers and light sources. Photoswitch Div., Electronics Corp. of America.

MECHANICAL POWER TRANSMISSION

119 Speed Reducer — Book 2618 contains 24 pp of engineering and selection information on single reduction drives in six sizes, with nominal ratios of 5 to 1 and capacities up to 50 hp, and double reduction drives in seven sizes, with nominal ratios of 15 to 1 and up to 40 hp. Photos and diagrams included. Link-Belt Co.

120 Roller Chains, Sprockets — Book 2657 contains 154 pp of detailed engineering data illustrating roller chain's versatility in a wide range of applications. A practical textbook on the use of roller chain for both power transmission and conveyor service, book contains typical installation conditions, formulas, charts and diagrams to simplify selection. Indexed for easy reference, it describes selection, application, installation, lubrication and maintenance. Also described are chain casings, lubrication and maintenance, sprocket engineering, leaf chains, roller chain flexible couplings and accompanying technical data. Book is available to qualified power engineers; please state your job title when requesting it. Link-Belt Co.

ELECTRICAL

121 Outdoor Motors — Six-pp Bulletin 2550 describes horizontal weather-protected motors from 250 to 2000 hp,

designed for outdoor use under extreme weather conditions. Cutaway drawings show construction. Standard and special features are described and specifications given. The Louis Allis Co.

122 Open-Type Motors — Super-Seal motors for many applications usually requiring enclosed designs are described in Bulletin 05-51B9040. Available in integral horsepower frames, these motors are reportedly unaffected by moisture, dust, dirt, oils, acids and alkalies. In addition to lower cost, they have a 1.15 service factor which often permits using a smaller size motor. An example of savings of 30 per cent on a typical pump drive is given. Allis-Chalmers Mfg. Co.

123 Wound Rotor Motors — Bulletin GEA-6713 describes wound rotor motors for crane or general industrial applications. Cutaway view shows internal construction. Ratings and dimensions are tabulated. General Electric Co.

124 Power Transformers — Preventive maintenance of power transformers through modernization is discussed in this 8-pp bulletin. Engineering analysis of a transformer's condition and the steps to be taken in its modernization are fully detailed. Westinghouse Electric Corp.

125 Dry-Type Transformers — Bulletin GEA-6790, 8 pp, describes new, lighter weight, aluminum wound sealed dry-type transformers rated 300 kva and above. Gives key standard and optional features of the transformers, design variations, and is illustrated with photos, charts, graphs and block diagrams. General Electric Co.

126 Motor Control Centers — Bulletin GEA-4979D, 12 pp, provides detailed descriptions of company's line of industrial motor control centers in NEMA Sizes 1 through 6, applicable to all industries where two or more a-c and/or d-c motors can be controlled from a central location. Describes features of equipment, provides data on minimum space requirements, includes planning charts, and provides sample specifications. General Electric Co.

127 Control Centers — Bulletin 402, 16 pp, describes features and advantages of motor controls centralized by Concentrol — with complete interchangeability of units and wire accessibility, front and rear. Suggested layout patterns are given, as well as dimensional tables and specifications. Continental Electric Equipment Co.

Postage-free cards for ordering bulletins are on page 105. You may also use the cards to order literature mentioned in the ads.

128 How Capacitors Help — Fourteen-pp Bulletin GEA-6715 tells how capacitors can provide savings on urban distribution systems, and serves as a guide in estimating amount of feeder load carrying capability which addition of capacitors will produce. Contains forms for calculating how many kvar should be applied to a given feeder, substation or system to obtain maximum loss reduction savings, and for determining where capacitors should be located. General Electric Co.

129 Stationary Batteries — Design improvements in company's line of stationary batteries featuring corrosion-resistant positive grids made of Silvium are detailed in 8-pp Bulletin 6205. Closeup photos and cutaway views are included, and plate construction features shown. Results of corrosion tests given. Exide Industrial Div., The Electric Storage Battery Co.

130 Lead-Calcium Batteries — Twelve-pp Bulletin CP-540 covers the use, design and construction of company's line of lead-calcium grid batteries for control, switchgear, auxiliary power and other stationary battery applications. Complete cell data are included, as well as curves on discharge characteristics, rack data, and accessory details. C & D Batteries, Inc.

131 Aluminum Rigid Conduit — This 12-pp booklet outlines briefly the mechanical and electrical advantages of aluminum rigid conduit. Specific installation instructions are included, as well as table of dimensions and weights. Aluminum Co. of America.

132 Improved Switchgear — Bulletin GEA-5664E is a 40-pp booklet on operation, characteristics and application of manufacturer's indoor and outdoor Metal-clad switchgear, rated 2.4 to 13.8 kv with interrupting capacities of 75 to 1000 mva. Describes Metal-clad's margins of versatility, system protection, safety, compactness, maintenance and ordering ease. Includes equipment and application photos, dimensional drawings and lists of basic and optional equipment. Also provided are ratings, equipment diagrams. General Electric Co.

133 Flow Switches — Bulletin FS-1 covers company's line of flow switches with a wide range of industrial applications. Details of construction are given, along with dimensions, typical applications, and flow diagrams. McDonnell & Miller, Inc.

134 Power Capacitors — Bulletin GEA-6662A, 8 pp, describes the outstanding features of company's corrosion-resistant 50 and 25 kvar power capacitors for high voltage applications. Pictures, cutaway and dimensional drawings, ratings and weights included. General Electric Co.

LIGHTING, COMMUNICATION

135 Mercury Floodlights — Bulletin GEC-1486, 8 pp, describes mercury vapor floodlights for parking lots, outdoor work areas, loading docks and similar areas. Heavy-duty, general purpose, and general-area floodlighting units from 100 to 1000 w are discussed. Also provided are application data, details of mounting methods, dimension drawings. General Electric Co.

136 Communication System — Featured in this bulletin is a transistorized communication system designed to provide communication between two or more persons or departments regardless of distance or surrounding noise conditions. Operating and equipment features are detailed, as well as economy of installation and maintenance. Gai-Tronics Corp.

137 Industrial TV — Twelve-pp Bulletin 2239, on use of TV in power plants, describes major types of industrial television equipment, gives selection suggestions, and illustrates these with case histories of successful operation. Fundamental problems of application covered are pertinent to any industry considering use of television as a tool of automation, as part of safety improvements etc. They include its use for stack observation, water level gage observation, flame viewing. Diamond Power Specialty Corp.

MATERIALS HANDLING

138 Vibrating Conveyors — Sixteen-page Catalog 66 is designed as a selection guide on vibrating conveyors for bulk materials. Gives information on materials handling operations that can be performed simultaneously while conveying, flow charts, illustrations of different types of applications, capacities, dimensions, and other selection data. Ajax Flexible Coupling Co. Inc.

139 Improved Conveyor Belt — Bulletin M302, 12 pp, on the Ray-Man conveyor belt, stresses compensation afforded. Pages are arranged to represent an actual cross-section of the belt, and text covers flexibility, resilience to shock loading, serviceability, other advantages of the belt. Raybestos-Manhattan, Inc.

140 Coal Handling — Increased importance of coal handling equipment in relation to over-all power plant design is discussed and illustrated in detail in 16-pp Bulletin A-2029. Describes methods of handling coal at steam generating plants, large and small, including barge and railroad car unloading facilities, storage and reclaim, conveying and elevating, crushing, weighing, sampling, distribution to bunkers and dust control. Link-Belt Co.

141 Coal Crushers — Provided in this 8-pp bulletin are details on company's AC series of rolling ring coal crushers. Illustrates construction features, gives performance data including capacities, speeds, weights and dimensions of various models. Also shows typical money-saving installations. American Pulverizer Co.

FANS

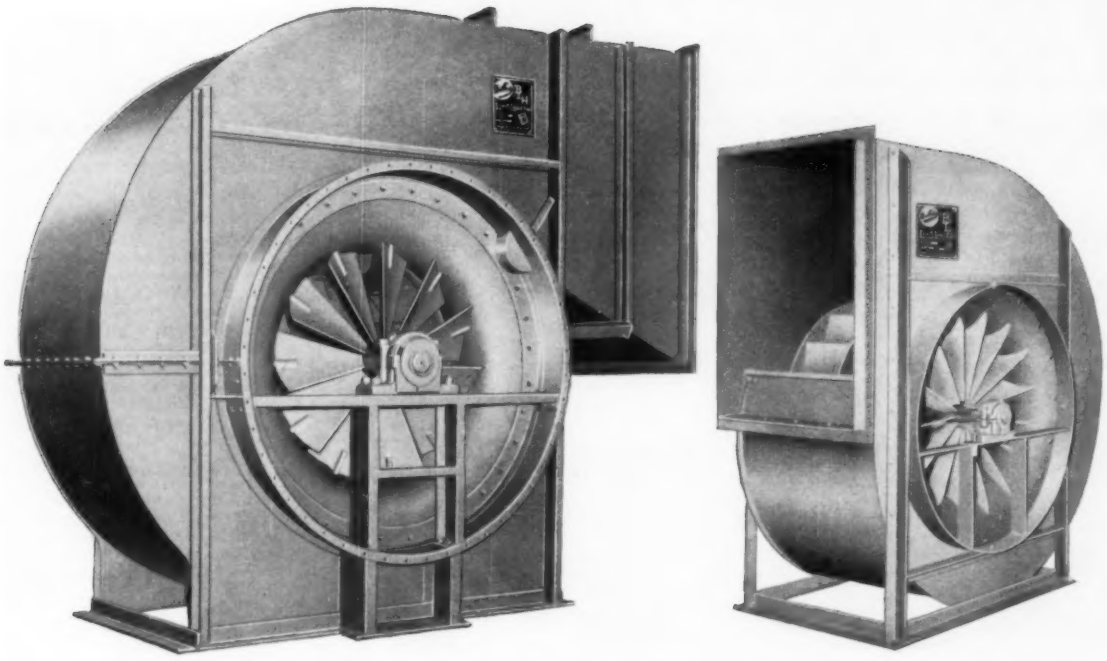
143 Industrial Fans — Bulletin I-585, 16 pp, describes company's industrial fans, and includes construction features, applications, fan arrangements and selection information. Temperature and altitude selection data, capacity tables, dimensions, special arrangements and types of fans are listed. The Day Co.

144 Tubeaxial Fans — Performance and dimension specifications on Series 300 tubeaxial fans are presented in 8-pp Catalog 1110-B. Charts recommended stack sizes, maximum horsepower, and maximum speed for variable stack velocity and air flow output. Westinghouse Electric Corp.

WATER CONDITIONING

145 For Water Treatment — Featured in this 8-pp bulletin is a range of equipment for water treatment, including aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters, and ion exchange equipment. Also describes and illustrates gas analysis and control systems, meters, flow controllers and air valves. The Permutit Co.

146 Deaerating Heater — Six-pp Bulletin WC-118A is filled with specifications and diagrams on a two-stage spray-type packaged deaerating heater with internal vent condenser and controls, in capacities ranging from 2,800 lb/hr to 100,000 lb/hr. Operation and design characteristics are detailed, diagrams showing how unit fits into various boiler feed sys-



LOWEST OPERATING COST OVER WIDEST PERFORMANCE RANGE OFFERED BY "BUFFALO" MECHANICAL DRAFT FANS

BLH—For Classes III and IV Service

Outstanding performance has characterized the "Buffalo" Type "BLH" Fan in a large number of Classes III and IV mechanical draft applications. A high mechanical efficiency is maintained over a wide operating range. Stability of performance is constant from free delivery to shutoff. In the "BLH" turbulence is reduced to a minimum by a combination of "Buffalo" features: smooth inlet bell, backward-curved blades, uniquely-curved rotor flange and divergent outlet. Traditionally superior "Buffalo" engineering and rugged construction insure top performance, extreme dependability, quiet operation and a long, maintenance-free life.

For full information on the "BLH", contact your "Buffalo" engineering representative, or write for Bulletin F-200.

BL—For Classes I and II Service

The high performance record of the "Buffalo" Type "BL" Fan is firmly established for most mechanical draft service in Classes I and II. Featuring non-overloading power characteristics, it provides stable, quiet output from free delivery to shutoff. A number of "Buffalo" engineering features contribute to the efficiency of the "BL". These include the "Buffalo" designed wheel, factory-balanced and tested to minimize vibration, and the wheel-suited housing's "free-flow" scroll design. The smoothly curved inlet bell is a strong factor in reducing turbulence.

Your "Buffalo" engineering representative will be glad to explain all the advantages of the "BL" — or write direct for Bulletin F-102.

Every "Buffalo" Fan brings you the advantages of the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Buffalo Pumps Division, Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

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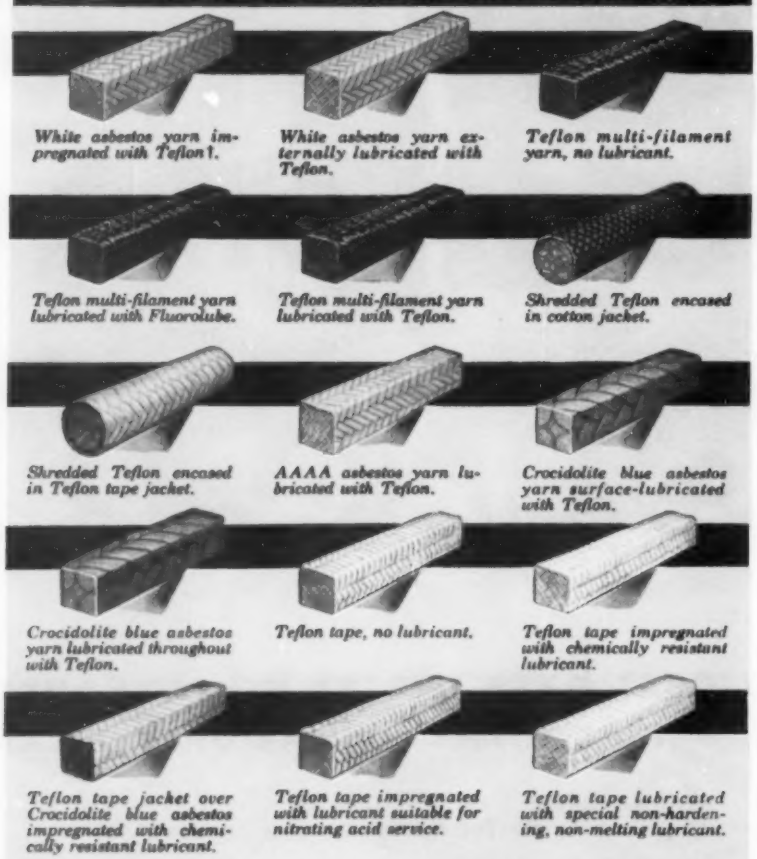
15 SPECIFIC PACKINGS FOR ALL CORROSIVE SERVICES


White asbestos yarn impregnated with Teflon†.
White asbestos yarn externally lubricated with Teflon.
Teflon multi-filament yarn, no lubricant.
Teflon multi-filament yarn lubricated with Fluorolube.
Teflon multi-filament yarn lubricated with Teflon.
Shredded Teflon encased in cotton jacket.
Shredded Teflon encased in Teflon tape jacket.
AAAA asbestos yarn lubricated with Teflon.
Crocidolite blue asbestos yarn surface-lubricated with Teflon.
Crocidolite blue asbestos yarn lubricated throughout with Teflon.
Teflon tape, no lubricant.
Teflon tape impregnated with chemically resistant lubricant.
Teflon tape jacket over Crocidolite blue asbestos impregnated with chemically resistant lubricant.
Teflon tape impregnated with lubricant suitable for nitrating acid service.
Teflon tape lubricated with special non-hardening, non-melting lubricant.

John Crane CHEMLON *BRAIDED PACKINGS

Specific service conditions are always best handled with a packing designed for the purpose. This is especially true when it comes to hard-to-handle liquids in pumps, valves, agitators, mixers, plating equipment and similar applications.

For this reason John Crane has developed 15 individual field-proved types of Chemlon Braided Packings. Within this line there is a type and style that will meet any combination of service conditions and requirements.

1. All known industrial acids, alkalis or solvents.
2. Temperatures from −120°F to +600°F.
3. High or low shaft speeds, also valve stems.
4. Longer packing life due to lower coefficient of friction and non-raveling construction.

Send in your service condition and we will recommend a Chemlon Braided Packing best suited to your application. Request Bulletin P-325.

Crane Packing Co., 6429 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

†*T. M. for DuPont Teflon* *T. M. for the Best in DuPont Teflon*

CRANE PACKING COMPANY

For more data circle 515 on Post Card

tems are included, as well as chart giving sizes, dimensions, space requirements. Graver Water Conditioning Co.

147 Feedwater Heaters — Six-pp Bulletin S-217 covers operation and features of baffle spray type deaerating feedwater heaters. Featured is a cutaway drawing, with step-by-step operating description, and a review of counter flow principle and reasons for a vent condenser. Selection data given. Stickle Steam Specialties Co.

148 Water Treatment Equipment — An outline of modern water treatment equipment is presented in this 10-pp bulletin. Discusses water impurities and methods of treatment, typical water-treatment systems, aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters, and ion exchange equipment. Lists nine ways to demineralize water, by ion exchange. The Permutit Co.

VALVES

149 Air Valve — High velocity air valve, composed of gang operated, Neoprene vane sections is described in 8-pp Catalog F-8752. Engineering data, dimensional, descriptive and application information is included. Barber-Colman Co.

150 Cushioned Valves — Nine automatic water control valves and their uses are described in 8-pp Bulletin G-5A. Featured are cushioned check valves, water level control valves, sensitive pressure regulators and one-man control valves. Photos of typical installations are included. Golden-Anderson Valve Specialty Co.

151 Servo Valves — Catalog 210 contains a series of curves and schematics which highlight the design and performance characteristics of company's low flow servo valves for a variety of applications. These valves are suited to situations requiring precise control at high power levels, including nuclear reactor control devices and a wide range of industrial installations. Moog Valve Co. Inc.

152 Filter Control Valves — Bulletin W-17 describes valves for surface wash water applications on filters and for controlling flow of water to filters. Operating layouts, operation, construction and dimensions, specifications are included. Golden-Anderson Valve Specialty Co.

OTHER EQUIPMENT

153 Dust Collector — Twelve-pp Bulletin J-616 describes company's Microdyne, a wet inertial type dust collector installed as part of the duct and a fraction of the size of many collectors of comparable performance. Photos show typical installations. Also provided are performance curves, specifications, cutaways showing inner construction, details on a related filter for reclamation or removal of collected slurry. Joy Mfg. Co.

154 For Quiet Heating — Described in this bulletin is the HusHeater, designed to heat — without making a sound — water and liquids by introduction of steam into the liquid. Lists advantages of the HusHeater, explains how to install it and tells how to order. Most common application is in filter boxes and hotwells, other applications are in heating processes in sugar refineries, paper mills etc. Sims Pump Valve Co., Inc.

155 Liquid Ion Exchanger — This booklet provides 17 pp of technical notes

ANOTHER **Vogt FIRST**

9 NEW FLANGED END FORGED STEEL

GENERAL G-P PURPOSE

Gate, Globe and Check VALVES

with

HARD FACED SEATS
150, 300 and 600 ASA STANDARD

featuring:

ASA Standard flanges and face-to-face dimensions
*Stellite hard faced seats and hardened wedges and discs
Spiral wound body-bonnet gaskets
Stainless steel gland studs and nuts
Interchangeable parts
Light weight with maximum strength
Complete line—pressures, sizes and types

**Union Carbide Corp.*

Write for Literature. Address Dept. 244-FPE

Vogt GENERAL G-P PURPOSE Vogt FOR BETTER VALVES

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VALVES

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81-19

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on Amberlite LA-1, liquid amine anion exchange resin. Nature and properties are discussed, along with details on handling and operational steps in use of the product. Among applications discussed are recovery and separation processes, purification of process streams, and pollution control. Resinous Products Div., Rohm & Haas Co.

156 Pipe Insulation — Advantages of lightweight glass fiber Micro-Lok pipe insulation are detailed in this 8-pp bulletin. Gives physical properties, thermal conductivity, types factory applied jackets, comparison of other insulation thicknesses required for equal efficiencies, guide to specifications for application and finishing, and dimensions. L.O.F. Glass Fibers Co.

157 Computer Control — This brochure describes a digital control computer and discusses process control, data logging, pilot plant and test facility applications for computer control systems. Detailed specifications are listed for the transistorized Model RW-300 for automatic on-line control of industrial processes. The Thompson-Ramo-Wooldridge Products Co.

158 Radial Engines — Bulletin 200A, 16 pp, describes company's radial engines, two-cycle diesel, spark ignition gas and Duafuel. Space-saving features and versatility of the radial engines are detailed, and schematic drawings, installation diagrams, cutaway photos and line drawings showing inner workings and detailed assembly of radial engines are included. Nordberg Mfg. Co.

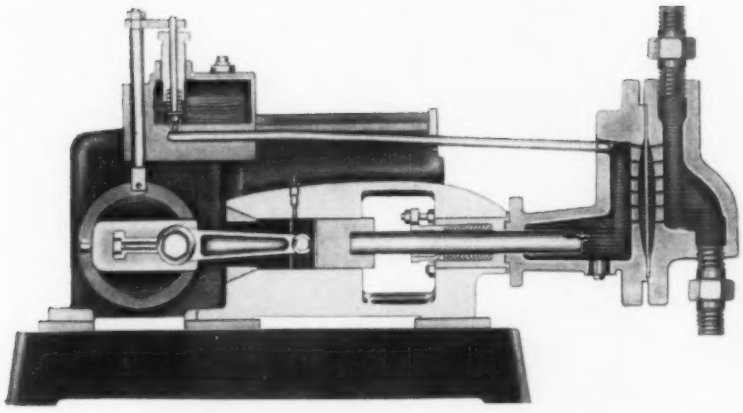
159 Relief Units — Automatic release for heat, smoke and explosive forces by means of Pyrojector relief units is fully explained with photos and engineering specifications in this bulletin. Damage prevention advantages are illustrated. The Swartwout Co.

160 Pipeline Sampling — Precise, automatic methods of sampling directly from pipelines are described in 8-pp Bulletin SM 9475-2. Illustrated bulletin describes technical aspects such as line stratification, flow profile, sample probe location, economic factors, basic methods — time-proportional and flow-proportional sampling. Proportioneers, Inc.

161 Magnetic Separator — Eight-pp Bulletin 1051 describes company's Indox V Drum Separator for removal of tramp iron in process industries. Discusses superior strength of ceramic magnet material utilized in the separators. Includes detailed specifications and dimensions, size chart. Stearns Magnetic Products.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

162 Process Equipment — Bulletin G-3B, 12 pp, discusses applications and performance characteristics of Fuller-Kinyon pumps, Airveyor pneumatic conveyors, Fuller-Huron Airslide fluidizing con-



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Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

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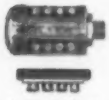
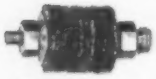
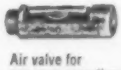


Expanding brush and replaceable element.



Sectional wire brush.



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veyors, rotary compressors and vacuum pumps, horizontal-grate coolers, Humboldt suspension-type preheaters, Lehigh induced draft fans and hot gas washers, positive pressure blowers and gas pumps. Operating principles are explained and typical installations illustrated. Fuller Co.

163 Firebrick Data — Power engineers, concerned with refractory maintenance and specifications in the ceramic, glass, metals, petroleum and marine industries will be interested in technical data card, Bulletin R-52. Summarizes technical data previously published by company, and is printed on card stock and punched for easy notebook insertion. Refractories Div., The Babcock & Wilcox Co.

. . . *Outstanding Among This Month's Catalogs*

164 Distribution Centers — Bulletin GEC-1355A, 28 pp, provides general and technical information on integral distribution centers, 112½ kva and above, liquid filled and 300 kva and above, open- and sealed-dry. Cites five advantages of the units, gives suggestions for use, and compares three types of transformers. A breakdown of incoming line (or high-voltage) section, transformer section, and outgoing (low-voltage) stationary molded-case feeder-breaker panel is included. General Electric Co.

165 Compression Packings — Featured in this 22-page catalog is a line of compression packings, including both the sheet and rod seal types. Describes packing materials and includes sections on recommended packings for various services, including air and inert gases, pharmaceuticals, foodstuffs and beverages, paper and textile processing, water, petroleum, acid service, alkalis and steam service, others. Packing recommendation chart is included. E. F. Houghton & Co.

166 Central Station Units — Catalog 39ACW-55, 72 pp, is arranged for accurate selection of central station Weathermakers, in capacities to 40, 750 cfm, for conventional and multi-zone applications. Dehumidification coils for direct expansion or chilled water can be selected by either wet bulb conditions or apparatus dewpoint temperature methods. All necessary engineering data is provided, including product features of these air conditioning units, mechanical and guide specifications, performance curves and rating tables for hot water and steam coils. Flexibility of the compact central fan-coil models is illustrated by sketches showing different arrangements of "building block" components. Carrier Corp.

167 Heating Devices — Catalog GEC-10051, a 52-pp 1958 guide on heaters and devices, supplies answers for hundreds of heating problems. Information is included on pipe heaters, thermostatically controlled immersion heaters, 1-in. diam water immersion heaters, new ratings and configurations of tubular heaters, others. Heating processes are described in a power requirements section. Typical application problems are solved to give heating requirements in a short-form method. General Electric Co.

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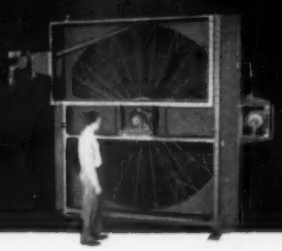
Ljungstrom® Package Air Preheater



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And when you credit fuel savings, the installed cost of a Package Ljungstrom can be paid for in approximately two years.

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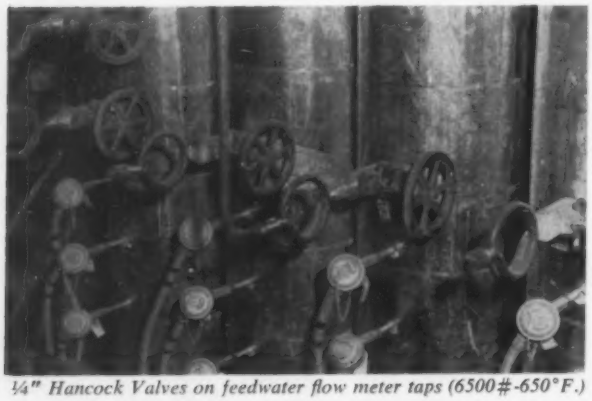
1¼" Hancock Valves in feedwater pump service (6500#-706°F.)



¼" Hancock Valves on feedwater flow meter taps (6500#-650°F.)

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VALVE DURABILITY
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Rated at 5000#-1150°F., Hancock Valves were selected for the new unit of the Philo Plant of Ohio Power Co. where boiler operation is at pressures and temperatures above the critical. *Stay-in-the-line durability* explains why design engineers and steam plant operators prefer these valves for feedwater service, drips, drains, vents and other piping.

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Sizes: ½" thru 2". OS&Y. Service Ratings: For all pressures up to 5000 psi at 1150°F. Weld Ends.

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Now... for the first time, basic principles used by RIC-WIL for decades are supported by extensive independent research. These principles are brought out in Technical Reprint #16, issued as a compilation of the results of a survey by the Building Research Advisory Board, of the National Academy of Sciences and tests made by the National Bureau of Standards. These criteria are also the basis of new Guide Specifications issued by several Federal Agencies, all of which include the basic principles of RIC-WIL Prefabricated Insulated Piping Systems. This survey is of such magnitude that it required over 2,000 man-hours and some 2,500 pages of documents and tests.

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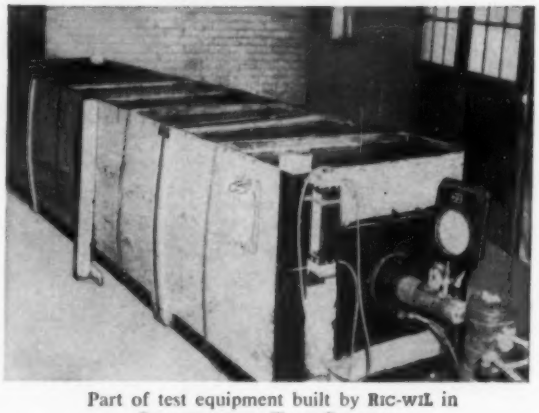

Part of test equipment built by RIC-WIL in QUALIFICATION TEST PROGRAM.

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Quality Piping Systems...
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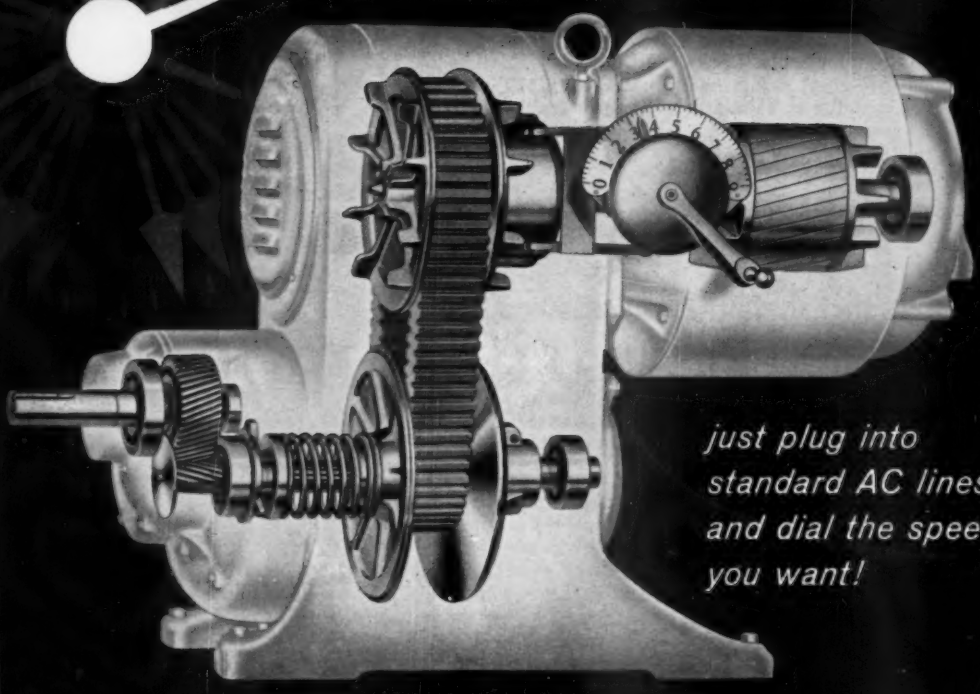

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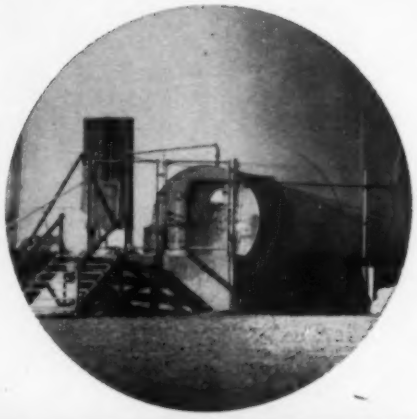
Nuclear power plant equipment

Personnel Air Locks meet AEC Code

G. E.'s Vallecitos BWR is one of eight atomic power plants that have installed or are planning to use Henry Pratt Air Locks. Pratt's experience in this field has developed a basic unit that can be modified for any reactor vessel. The Henry Pratt "door" includes some very desirable features . . . an interlocking device that keeps one door open when the other is closed, automatic or manual controls and choice of compression or pneumatic door seals. Locks are built to withstand any practical pressure, size is no problem, an 8'x10' lock at G. E.'s Test Reactor at Vallecitos will admit trucks.

Write for full details.



Butterfly Valves that shut in 3/10 of a second

At the MIT Research Reactor two 30" Pratt Quick Acting valves are used in the ventilating system. Their split-second closure is necessary to maintain the integrity of the protective vessel in case of reactor incident. The valves are oil cylinder operated and were shipped complete with a "power package" for easy installation.

These *standard* Pratt valves were chosen for abnormally severe service . . . excellent evidence why Pratt valves are so widely used for handling large volumes of water in condenser service, pump discharge or other power plant applications.

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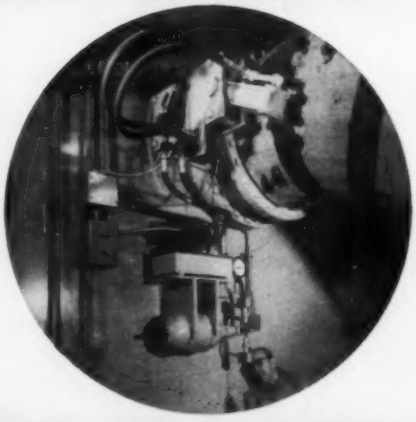

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This rubber belt expansion joint provides a flexible, vacuum tight connection between the turbine and the condenser—and greatly reduces time, trouble and costs in engineering and construction. A reasonable tolerance can be allowed because the Pratt Expansion joint absorbs up to 1" of axial and ½" of lateral movement. Round or rectangular units can be built to any size. If one dimension is less than 14'9", the joint can be shipped fully assembled.

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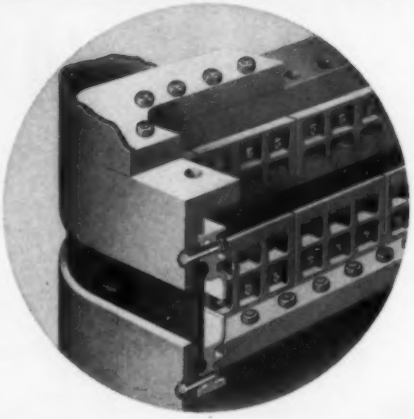

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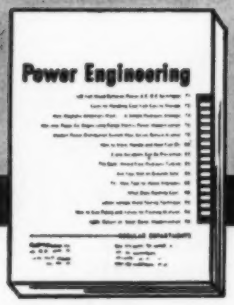

ATOMICS

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A POWER ENGINEERING FEATURE FOR UTILITY & MAJOR INDUSTRIAL EXECUTIVES

A. W. Kramer, Editor

A Periodic Report on Atomic Energy Development Throughout the World
Published by Technical Publishing Co.

November 1958

Geneva vs Montreal. It was somewhat unfortunate that the World Power Conference in Montreal, September 7 to 11, was scheduled during the same period as the Conference on the Peaceful Uses of Atomic Energy at Geneva, since many prominent engineers and scientists in the nuclear field who felt it necessary to attend the Geneva meeting would otherwise have attended the World Power Conference in Montreal. While it was reasonable that Geneva should have first call on the scientists who are engaged in nuclear development, the future of atomic energy rests on its ability to integrate nuclear power (on the basis of competition with hydraulic and conventional fuel resources) into the power systems of the world. As Sir Christopher Hinton, Chairman of the Central Electricity Board of Great Britain expressed it in his address at Montreal, "I hope I may be forgiven if I suggest that the atomic energy organizations of all countries would have been wise to make recognition of this fact by a more even distribution of its technologists (as distinct from scientists) between Geneva and Montreal."

As it turned out, judging from early reports from Geneva at this writing, (Sept. 23), there were probably more nuclear experts than were needed or could be accommodated comfortably at Geneva. More than 5000 delegates and visitors from 69 countries were in attendance at the Geneva meeting.

While all phases of nuclear power development were discussed at Geneva, the highlight of the conference was the importance accorded the subject of controlled thermonuclear power. At the previous Atoms For Peace Conference in Geneva, in 1955, the subject of controlled thermonuclear power was just barely considered, when Homi Bhabha of India, the Conference President, brought the subject up in his opening address. Until that time virtually nothing had been said about fusion, and Bhabha's remarks had an electrifying effect not only upon the Conference but upon the attitude of scientists throughout the world.

The three years since the 1955 Conference have made a tremendous and extremely welcome change in the attitude of all countries toward thermonuclear research, and at this last Geneva Conference there was almost too much thermonuclear information to comfortably assimilate. Not only were there thermonuclear devices in actual operation but also models of future ones, indeed the large number of exhibits, their complexity, and varied nature tended to overwhelm the visitors. All of it was in the open, however; there were no secrets. Russia sprung a surprise in the disclosure of their OGRA, the huge thermonuclear machine which is undoubtedly one of the largest and elaborate in the world. The quantity of printed material was astonishing -- never was there such an outpouring of nuclear information. All in all, some 2300 papers were submitted by 44 countries -- 13 of these countries presented papers dealing with controlled thermonuclear power. A dramatic announcement was made by the United States and the United Kingdom just before the opening of the conference. This concerned the total declassification of

information in the field of thermonuclear research. Ideas in the controlled thermonuclear field will no longer be born classified.

The importance of the complete declassification in the field of fusion was recognized by all participating countries. L.A. Artsimovich, who presented the leading paper on thermonuclear work in Russia, commented on this move in enthusiastic terms: Said he, "For the first time, these results will be discussed on an international scale, and this is probably the most important step that has been made towards the solution of this problem. The importance of this fact is greater than that of the separate investigations which as yet have not brought us very much nearer to our ultimate goal."

Despite the astonishing array of controlled thermonuclear devices on display it was quite obvious from the papers and the discussions that success in this field of research is still a long way off. Much of the optimism that characterized the early disclosures of research on fusion had disappeared, and in its place was a more realistic appraisal of the nature and difficulties that lay ahead. Of interest were the many different approaches in thermonuclear research. The pinch effect, which had been involved in so much of the early work, seemed to be less of a factor in present research despite the continued efforts of the British to base their work on the pinch. Of course, the pinch approach possesses a basic simplicity which had great appeal in the beginning. It does not require elaborate or expensive apparatus in order to obtain interesting experimental information. It has, however, had to cope with severe plasma instability problems. Neutrons have been produced in pinch devices under conditions which suggest thermonuclear origin. The United States, Britain, and Russia have all used the pinch and while the first results were encouraging it is sobering to reflect that the number of neutrons produced (up to about 100 million per pulse) falls far short — by a factor of a billion or so — of representing the return of as much energy as was required to produce them.

There has been much discussion as to whether the neutrons produced in pinch devices are of a thermonuclear nature or the by-product of other plasma phenomena. This question, as far as the Geneva Conference was concerned, was more or less academic, one which at this time was of little relative importance. It is possible that some of the experimental apparatus is producing thermonuclear reactions on a small scale and that, with improved techniques and larger machines, a much greater yield of neutrons will result. There was, in fact, general agreement that the origin of neutrons was not important; the problem was how to get more of them. As expressed by Prof. Artsimovich, "When the number of neutrons reaches a value in excess of 10^{12}, then all doubt as to the origin of this effect will disappear."

It was obvious from the general discussion that much work remains to be done on the study of plasma physics. Russian calculations, taking into consideration factors which had not been evaluated before, indicated that radiation losses from very hot plasmas may be much greater than previously supposed.

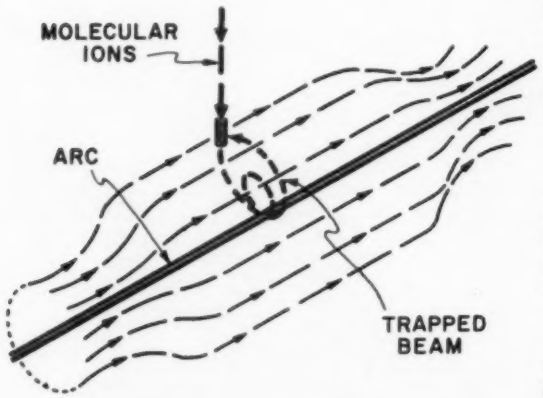
Of great interest was Oak Ridge's DCX described in paper 344 by C. F. Barnett and others. This device, which is part of Oak Ridge's experimental program, is based on dissociated trapping of energetic ions. The Russian OGRA is somewhat similar to the DCX machine, and it also, is based on magnetic trapping of ions. The basic principle of the Oak Ridge experimental work can be explained in the following way: Molecular deuterium ions, each consisting of two deuterons and one electron, are supplied at high energy in the form of a beam from an accelerator, and injected across a magnetic field into a vacuum chamber. Ordinarily an ionized molecule so injected will move in a large circle if the field is uniform, and return to strike the source from which it was injected. Trapping can occur, however, if the molecular ion is dissociated or broken up at some suitable point in its orbit, thereby altering the charge-to-mass ratio.

The molecular ion can be dissociated into two particles: a single positively charged deuteron, and a neutral deuterium atom, consisting of the remaining deuteron and the electron. This can be expressed as follows:

$$D_2^+ \rightarrow D^+ D^0$$

The neutral atom is not acted upon by the magnetic field and immediately escapes. The positive deuteron, on the other hand, with the same charge and velocity, but only half the mass of the original molecular ion, will move in a new orbit which has a radius only half as large. Consequently it cannot come back and strike the source; it will continue to circulate in its orbit.

The scheme would be of merely academic interest unless highly efficient means were actually available for dissociating molecular ions at the proper point. This means was suggested by John S. Luce who discovered that an unusual type of electrical discharge — a high current vacuum arc — could dissociate molecular ions with remarkably high efficiency over a wide range of ion energies. These arcs have electron energies of tens to hundreds of electron-volts and require an axial magnetic field for stable operation. Arcs as long as 6 ft have been drawn at 150 v and 250 amp. These arcs are still only partly understood, but their effectiveness is demonstrated by the results with DCX. The general principle of the DCX is shown in the diagram.



The Russian OGRA is based upon this general principle but does not use the arc that is so effective in the DCX, and at the Geneva Conference the Russian scientists were anxious to obtain further details of this remarkable arc.

It was quite obvious from the large size and state of development that the Russian machine was designed and built independent of knowledge of the Oak Ridge machine.

Reactor Progress. A somewhat significant, and to some a disappointing, feature of the Geneva Conference was the lack of new ideas in the field of fission reactor technology. While there were many papers describing advances in various types of reactors, the reactors themselves were the same types which have been in the course of development over the last three years. The Russians described a zero-energy uranium hexafluoride gas fueled reactor, but this concept is not new since a reactor of this type has been under study in the United States by Burns & Roe for some time, and was described in the August 1958 issue of Nucleonics. The German Pebble Bed gas-cooled reactor being built by Brown Boveri, and Krupp, while intriguing, was not new, since a Pebble Bed reactor of this kind has been under development on this side of the Atlantic by Sanderson & Porter for several years. This project was described in Power Engineering in August 1957.

Of course, much interest in reactor development centered upon what the Russians had accomplished since the 1955 Conference at Geneva. At that Conference they had described their first 5000-kw nuclear plant near Moscow but since that time very little reactor information had come from Russia. At this last Conference, however, the USSR gave a good account of its activities in the field of practical power reactor development and this was quite good, and quite varied in scope, indeed, in many ways it paralleled reactor development in the United States. Russian development involves pressurized water reactors, boiling water reactors, homogeneous, sodium-graphite, fast breeder, intermediate neutron, and gaseous fuel reactors. Steam pressures vary between 90 psi and 1300 psi, and steam temperatures as high as 900 F are used. While Russian reactor technology was good, and quite impressive, it was not necessarily better than U. S. reactor development. Perhaps the most startling event of the Conference was the announcement by the Russians that they had just brought to full power a new 100-Mw (e) dual purpose power and plutonium reactor in Siberia. This, however, is only the initial installation of a six unit station totaling 600 Mw (e). The reactor is light-water cooled, graphite moderated, and uses natural uranium as fuel.

From a Practical Standpoint the discussion of power reactor technology at the Montreal World Power Conference was perhaps more valuable than that which went on at Geneva, since it was concerned less with description of nuclear power stations than with their economics and integration in systems involving other types of power plants. At Montreal there was a frank realization that the early excitement and interest in a wide variety of possible reactor types was subsiding and being replaced by sober concentration on a few. There was perhaps more emphasis of nuclear power costs at Montreal than at Geneva.

It was very obvious from the discussion that despite the fact that a number of nuclear power stations have gone into service throughout the world, the question of costs is still in a nebulous state and subject to varied opinion. With regard to actual experience, Great Britain, of course, enjoys an advantage because of her pioneering experience with Calder Hall. Calder Hall has already pointed the way to economies in construction which are being used effectively in the construction of Bradwell, Hunterston, Hinckley Point and other British nuclear stations under construction.

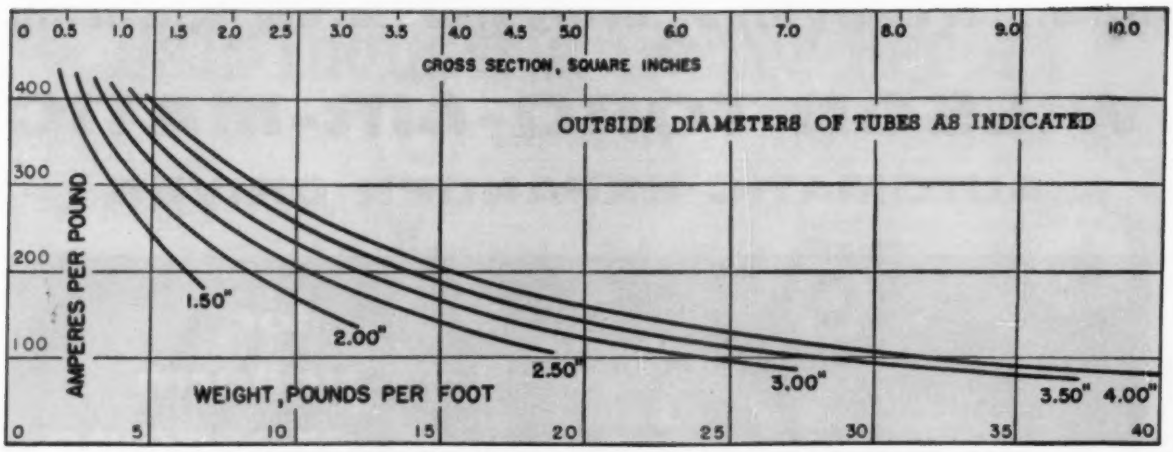
The United States has the largest and most varied experience with reactors and this formed the basis of a very interesting paper presented at Montreal by Donald H. Stewart. He listed nine civilian power reactors which have produced electricity, and analyzed their capital costs. While there were many ways by which capital costs might be reduced, Stewart felt that the most immediate reductions in capital cost per kilowatt could be obtained by building nuclear plants of larger size. Another factor that will reduce construction costs is the standardization of reactor components. Reactor designers have been inclined to insist that components such as fuel elements, pumps, valves, control system and fuel handling apparatus be specially designed for each reactor. Costs of specially manufactured items are very high. Experience is indicating that in a number of these areas standard equipment can replace the specially designed equipment presently used. This is a reflection of increased knowledge and confidence which can result only from operating experience. There is a limit to the cost reductions to be expected from standardization of components, however, because even when reactor components become standardized, they will prove more expensive than conventional items. The penalty for component failure is more extreme than in a conventional system due to induced radioactivity which makes maintenance difficult.

Operating experience is also demonstrating many areas where performance improvement and design simplifications can be achieved. This experience will before long permit designers of full-scale prototype plants to substitute confidence based on knowledge for excessive conservatism. For example, the Experimental Boiling Water Reactor at the Argonne National Laboratory has demonstrated a capability of operating at three times its design power of 5000 electric kilowatts. Improvements in performance such as this can reduce capital costs by large factors.

As far as operating costs are concerned, Mr. Stewart said that experience to date has shown that there is no reason to believe operating costs of a large nuclear plant will be higher than those of a conventional steam plant. Essentially the same number of persons is required for either system and, with proper training, it appears that comparable job classifications will be involved.

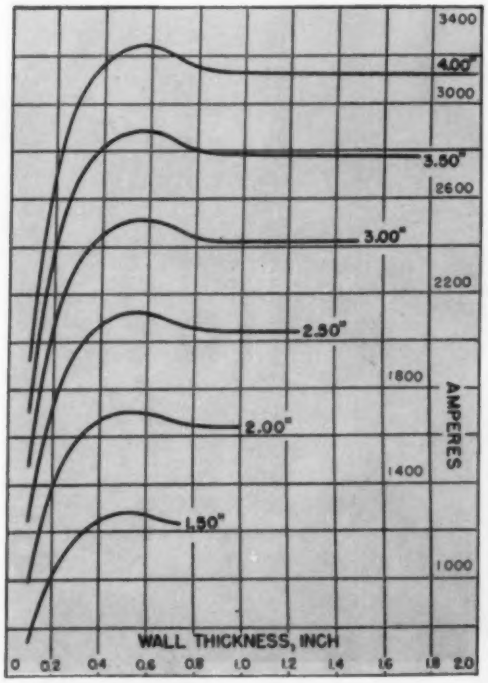
The effect of capital costs on final power costs, especially under private financing, is so large that it may determine the selection of fuel enrichment. There is a strong feeling in the United States that the somewhat higher fuel costs incurred by the use of slightly enriched fuel instead of natural uranium are more than offset by savings in capital costs. These savings come about because enrichment permits reactors with smaller physical sizes for given heat outputs, higher specific powers, and more freedom in the choice of materials and designs.

Andrew W. Kramer



60-CYCLE CURRENT ratings of six round copper tubes in terms of weight per foot.

How to carry more amperes per pound of copper



THE INFLUENCE of wall thickness on the 60-cycle current rating of six round copper tubes.

THIN-WALL TUBES with low wall-thickness-to-diameter ratio offer decided electrical advantages—and opportunities for cutting bus costs—wherever mechanical requirements permit. The charts above and at the left show the 60-cycle skin-effect phenomenon characteristic of six representative sizes of round copper tube, 1.5" to 4.0" O.D. The curves cover the entire range of wall thickness from solid round rods, at the right, to the thin-walled tubes in common use at the left. What is true of round tubes is also true of other tubular bus shapes.

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More complete information on tubular conductors is available in the Sixth Edition of The American Brass Company's Publication C-25. This 62-page booklet has a wealth of general information on the properties of copper conductors—plus convenient data for the most commonly used sizes of all types of rigid bus conductors.

TECHNICAL SERVICES. Anaconda specialists are available to help you in the solution of technical problems involving the use of Anaconda Bus Conductors. For such service, or for a copy of Publication C-25, see your nearby Anaconda representative. Or write: The American Brass Company, Waterbury 20, Conn. BT100

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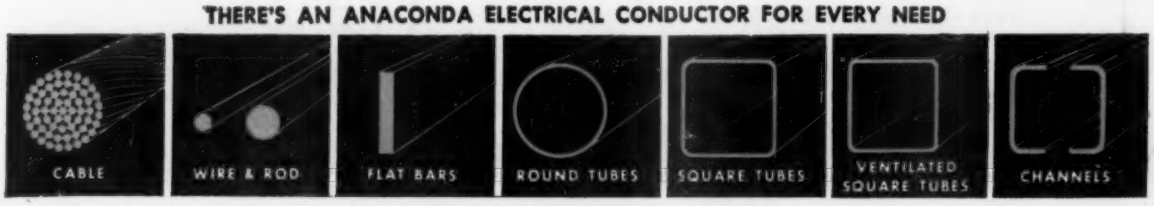

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Hall Industrial Water Report

VOLUME 6 NOVEMBER 1958 NUMBER 6

From Kerosene to 100 Octane

The cat crackers of today's oil refineries bear little resemblance to the batch stills of yesteryear. But the old and the new do have one thing in common—water problems. Treatment of water for boilers has become more critical because of higher pressures and ratings and greater necessity for avoiding interruptions in production. The same is true of service and cooling water treatment. And waste water problems are becoming more acute because of the pressure to conserve water and clean up our lakes and rivers.

Hall Laboratories engineers have been working with water in refineries as well as in other industries for more than thirty years. They are ready to help you with all your water problems.

Sweetening Sour Water

Deposits formed so rapidly in the sour water deodorizing tower at a Canadian oil refinery that chemical cleaning was required every month. Each cleaning job cost $600.

When he learned of the problem, Hall engineer J. S. Sullivan recommended the use of Calgon and Hagan Dispersive. The cost of these chemicals would be only a fraction of the cost of chemical cleaning.

After treatment was started the tower operated without any indication of deposit formation and inspection was postponed for three months. When the tower was inspected, Sullivan and the operating men were gratified to find it clean.

Failure in Sixteen Days

A Northwestern oil refinery installed two boilers, and a hot process lime-soda softener to treat the hard, high solids feedwater. Operation was started without phosphate conditioning of the boiler water and sixteen days later one boiler was out of service with ruptured tubes as a result of scale formation.

In response to the call for help a Hall engineer left for the plant immediately. He found that plant operation depended upon keeping the remaining boiler in service. This seemed doubtful because a peek into the furnace revealed overheated spots on many tubes, a literal red light warning of insulating scale within them.

There was no time to start with a low phosphate feed and to gradually build it up so as to avoid rapid loosening of scale and possible tube blockage. Full phosphate conditioning was started at once. Then the Hall engineer had to sweat it out. Would there be tube trouble? Would carryover occur because of high concentrations? Fortunately, neither occurred. Within 24 hours the overheated spots disappeared and everyone relaxed.

Without proper conditioning of the boiler water, tubes failed in sixteen days. Following the establishment of desirable conditions many years passed without further difficulty.

Saving by Wasting

A petrochemical plant used well water for cooling in once-through services which required colder water than the cooling tower could deliver. Practically all of the well water was then discharged to the cooling tower system as make-up. Since this was far more water than was actually required for make-up, the amount of blowdown from the recirculating cooling system was about four times what it should have been.

Treatment of the recirculating cooling water for corrosion control involved the use of sulphuric acid, Calgon® and Coraid.® Hall engineer S. R. Osborne pointed out that the excessive blowdown was resulting in the wastage of large amounts of chemicals—more than $60.00 worth a day. He recommended that this be saved by discharging to the sewer all of the well water not actually required for make-up to the recirculating cooling system.

In most plants Hall engineers are looking for ways to save money by reusing or recovering cooling and waste water. In this case the plant could save about $22,000 annually by wasting rather than recovering once-through cooling water.

Pitted Gauge Glasses

A very common problem often puzzling to boiler operators is the internal wastage of glass above the water level in gauge glasses. Water level visibility is impaired and sometimes the glasses are weakened to the point of failure.

When this problem was first referred to Hall Laboratories years ago, study by the Hall research staff revealed an interesting process of corrosion.

Steam is continually condensing on gauge glasses above the water level. The hot, pure water slowly dissolves the glass. Sometimes dissolved silica reprecipitates as an opaque deposit which imparts a frosted appearance to the glass.

There is no way to modify boiler water treatment to prevent or control the trouble. When flat or prismatic glasses are affected replace them with mica-backed flat glasses. When tubular glasses are involved, try to obtain a more resistant glass.

Free Copies of Water Lecture Available

A limited number of free copies of "Your Most Important Raw Material," the Edgar Marburg Lecture by Dr. Everett P. Partridge, are now available. For your copy or for information on how the Hall System can help solve your particular water problems, write, wire or call address below.

Water is your industry's most important raw material. Use it wisely.

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Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

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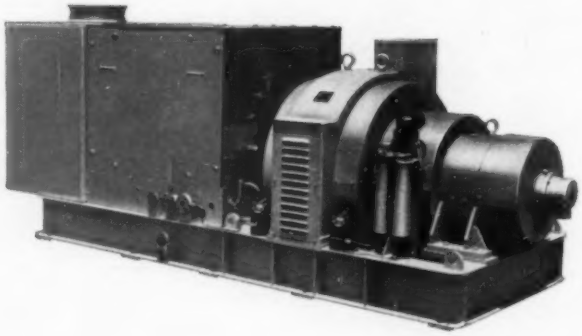
Solar's 300-kw gas turbine generator offers 5 unique advantages



① **Compactness, light weight, low-cost installation**
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POWERED BY A 500 hp Jupiter® gas turbine engine . . . Solar's 300-kw generator set weighs only 6900 pounds and is considerably smaller than the average automobile! Installation is easy . . . and *costs less* . . . because lightweight, vibration-free gas turbine generators require no foundation.

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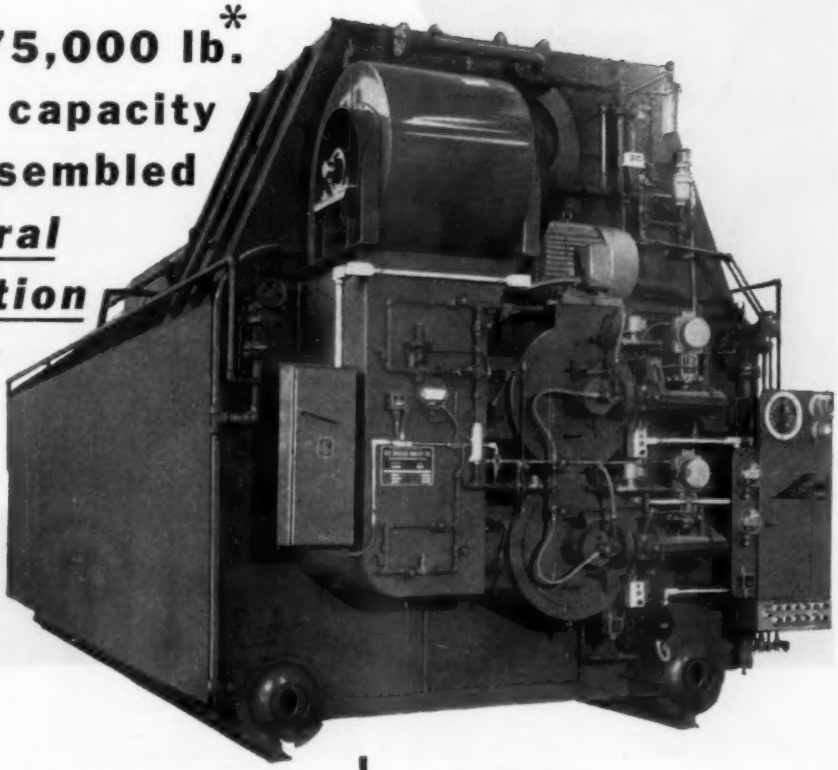

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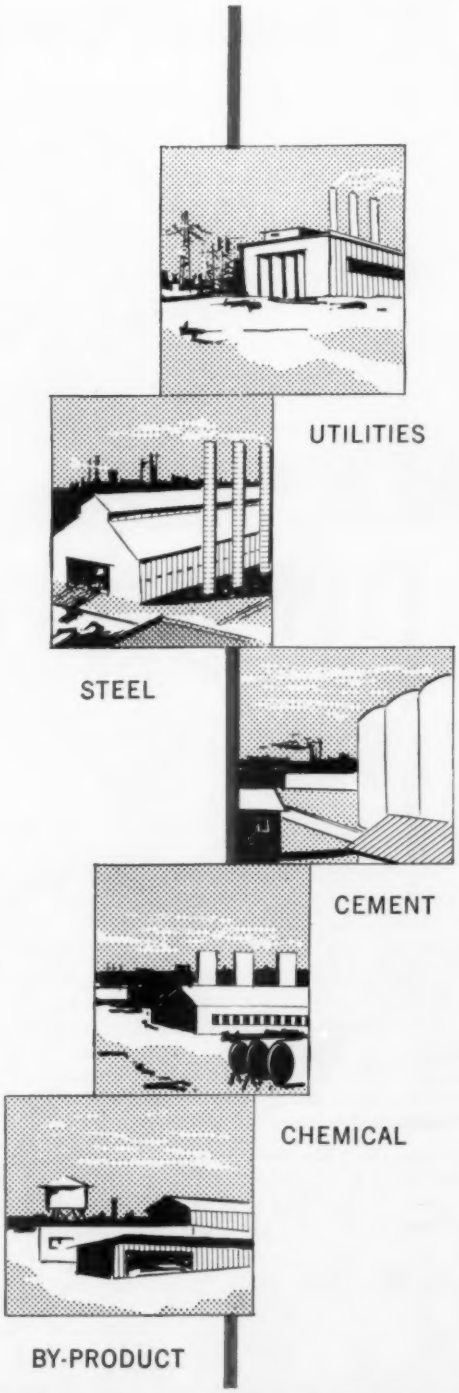

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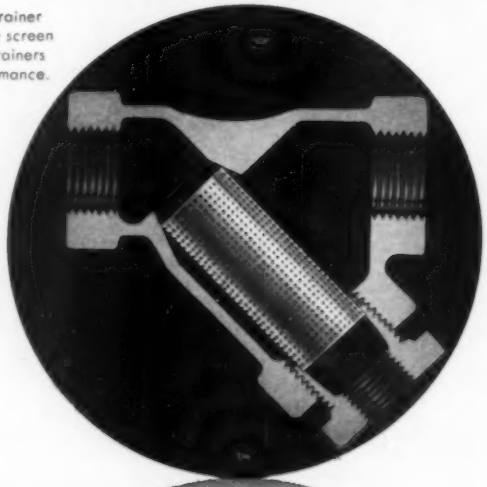
protect your equipment against scale and dirt

Exterior view of NEW Sarco Type "AT" Pipe Line Strainer. Note 45° blow-down angle to facilitate piping away from strainer.

with this

NEW SARCO TYPE "AT" PIPE LINE STRAINER

Cutaway of NEW Sarco Type "AT" Strainer shows sediment collection chamber below screen. Standard screen used in Sarco "AT" Strainers is key to their uniformly successful performance.



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The Sarco screen, key element of the unit, fits tightly into a long, tapered screen seat. This feature absolutely stops the by-passing of particles around the screen. Secondly, the rigid, welded construction of heavy-gauge brass makes sure the fit will remain tight, even when trapped sediment builds up pressure.

Third, you'll see that the new AT is easy to clean. No sharp edges or weave crevices in the screen for particles to cling to. Blow-down cleaning is simplified by the 45° angle construction.

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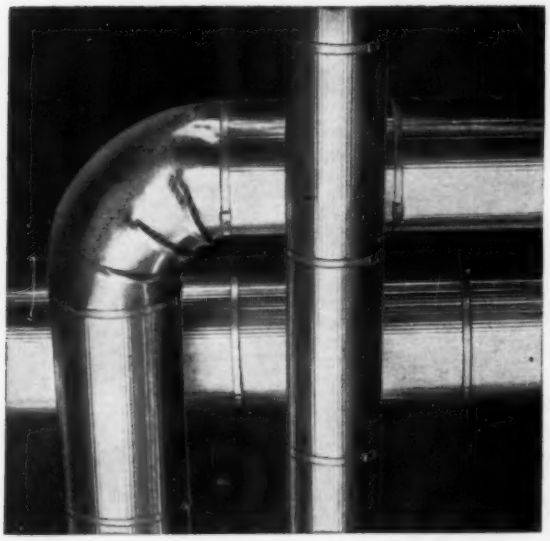

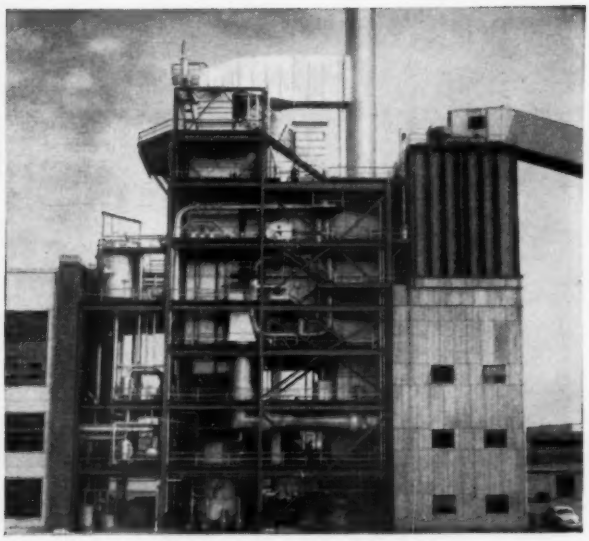

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Greater strength at less cost is yours with Childers Cross-Crimp®. Tests prove the rolled-in 3/16" cross corrugation increases the vertical strength and rigidity of .016" thick aluminum to that of plain .024" thick aluminum. Jacketing costs are consequently reduced as much as ⅓ when Childers Jacketing is used instead of ordinary sheet aluminum.

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First cost is less for Childers Jacketing and Ell-Jacs than for any other permanent-type protection—even less than some temporary coverings which require constant maintenance, repair and replacement.

Installation is easy. Two men can do the job. Best method of attaching jacketing is with aluminum strapping and seals. Only pliers and screwdriver are needed. Childers Ell-Jacs are applied with aluminum sheet metal screws. Jacketing and Ell-Jacs can be removed to inspect lines, then reapplied without waste.

Engineering Representatives in 27 cities provide technical information and assistance on protection of insulated lines, elbows, towers, vessels, tanks. Only Childers has this nationwide service organization.

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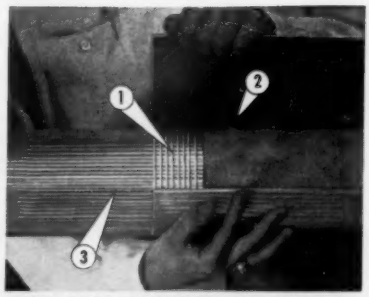
In Canada, write direct to Peerless Mfg. Co., Sub-Post Office 28, Calgary, Alberta.



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Only Childers makes available to you complete specifications and engineering data on aluminum jacketing in these catalogs: Sweet's Industrial Construction File pp. 6b/Ch; Chemical Engineering Catalog pp. 530a-d; Refinery Catalog pp. 341-4.

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Cross section Yarway No. 30 shows lever valve in open position.

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POWER PLANT AND MARINE SERVICE Yarway Integral Strainer Traps fill the bill for marine and high pressure power plant jobs

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TRACERS

Power Engineering's Monthly Probe of Power Facts

Synchronized with the system October 20, Detroit Edison River Rouge Plant's Unit No. 3 has one of the lowest heat rates in the world — 8950 Btu per kwh. The 300-mw unit takes steam at 2400 psig, 1050 F from the 2,000,000 lb-per-hr boiler, with reheat to 1000 F. One of the most interesting and important features of the plant are the two sets of tandem regenerative air heaters. The two hot-air heaters are located ahead of the flue dust collectors, and cool the gas from 680 F to 312 F. The cold-air heaters, located after the flue dust collectors, cool the flue gas to about 210 F. The cold-air heaters are porcelainized.

Both mechanical cleaning and acid cleaning were too time-consuming and presented difficulties. Instead, Republic Steel's power plant in Cleveland tried a new method. It uses chelating agents called Versene, introduced into the boiler in a water solution. Method's proven advantages are formidable. John J. Alexander describes results in detail in his article on page 61 of this issue.

New line of power-recovery gas turbines is offered by the Elliott Co. Turbine is designed to expand waste process gases at temperatures up to 1250 F, and the turbine-driven compressor delivers air to the process at pressures of from 30 to 200 psig. Substantial reduction of process operating costs is reported.

Closed-circuit TV system capable of providing a clear picture in temperatures exceeding 2000 F has been marketed by G-E. The new system uses an air-cooled lens that allows remote viewing of boiler flames or "hot" areas without danger of the lens melting.

First commercial saline water conversion plant east of the Mississippi River recently began operation at a restaurant on the New York State Thruway, near the Finger Lakes Region of upper New York State. The desalter, built by Ionics, Inc, will remove about 200 lb of undesirable salts each day from 12,000 gal of brackish well water to provide fresh, potable water for domestic use as well as for air conditioning and boiler make-up.

Silicone-insulated motors have operated continuously at 300 C for 6600 hours, and for 8000 hours at 280 C. So reports L. J. Stage of Sun Chemical Corp. On this basis, Stage concludes, such material, run at the present hot-spot allowance of 180 C, would have a life of over 1000 years.

After rigorous testing, plastic pipe for street-to-house water service line has been approved by the Cleveland (Ohio) building code. This is the first major city in the U. S. to give such approval.

Shear strength of 495 psi at 600 F is reported for a new family of synthetic-rubber phenolic-resin-base adhesives now being introduced by Raybestos-Manhattan for industrial use.

Fig. 1. The opening general session of the World Power Conference at the Queen Elizabeth Hotel in Montreal, September 7, 1958

World

WITH QUIET DIGNITY, and smoothness reflecting the efficient organization of this famous international engineering body, the World Power Conference convened in Montreal on September 7. In its quarter century of existence involving 16 meetings, this was the first meeting held in Canada, the second in North America, and the third in the Western hemisphere. The Canadian National Committee was host and the meeting was held in the new Queen Elizabeth Hotel in Montreal.

Three levels of government, dominion, provincial, and municipal, were represented at the opening ceremonies welcoming more than 1200 delegates from 51 different nations. Eight nations responded to the formal welcome. To engineers, however impressive the formal opening ceremonies may have been, the real significance of this meeting lay in the technical sessions that were to follow and in the opportunity it provided to discuss the technical and economic problems of power development with engineers and scientists from nations all over the world.

The theme of this Canadian Sectional Meeting — Economic Trends in the Production, Transportation, and Utilization of Fuel and Energy — is particularly important in the present stage of world development, when there is an ever-increasing demand for energy in all its forms, not only in the less developed countries, but also in those regarded as well advanced. As expressed by Sir Harold Hartley, Honorary Chairman, Past President of the World Power Conference and official representative of the British Government, in his response to the formal welcome, "Your choice of the theme for the meeting is so opportune. Every nation is energy-conscious today. Never before has there been so wide a range of sources of energy from which to choose, and the economic advantages of each under varying circumstances are set out so well in the papers we are here to discuss."

Official representative from the United States was K. M. Irwin, Chairman of the U. S. National Committee. His response to the welcome was simple and informal. Said Mr. Irwin, "Such a gathering affords us, in addition to its technical aspects, the opportunity to meet old friends and make new ones."

Aside from Canada, which naturally had the largest number of delegates, the United States and Great Britain were especially well represented, with well over 130 delegates each. The Soviet Union sent 17 delegates, headed by A. S. Pavlenko, Chairman of the National Committee for the USSR, and the Minister of Power Stations in the Soviet Union. "The problems on the agenda of this Conference," said Mr. Pavlenko in his response to the welcome, "are especially interesting to Soviet power engineers since our country is carrying out a great program of power construction. The problem that we are confronted with is to raise the production of electrical energy to 850 to 900 billion killowatthours within the next 15 years. This is almost four time greater than the energy generated at all our power stations this year." An interesting feature of the meeting was the showing of several reels of motion picture film which the Russian delegation had brought to the Conference. These films showed the construction of the Kuibishev project, the dedication ceremonies at Kuibishev Dam early last summer, and the general program of power construction in the USSR.

Fig. 2. Power Engineering's four editors who attended the Montreal Regional World Power Conference meeting. From L to R, A. W. Kramer, Editor of Atomics; R. F. McCaw, Managing Editor; C. R. Earle, Editor; R. H. Morris, Editorial Director

The Technical Sessions

The technical sessions covered the entire range of technology concerned with the production, transportation and utilization of all forms of energy — hydraulic, thermal, and nuclear. A desirable feature of the technical program was that there were no concurrent sessions, hence, every delegate could attend all the sessions. All

Power Conference, Montreal, 1958

Economic Trends in the Production, Transportation, and Utilization of Fuel and Energy was the theme of the Canadian Sectional Meeting of the World Power Conference held in Montreal, September 7 to 11

papers were available in printed form at the opening of the Conference and the papers were presented by name only. As in previous World Power Conferences, A General Reporter was appointed for each technical session, whose function it was to summarize the discussions at the end of each session.

The official languages of the Conference were French and English and all discussion was translated, simultaneously into either of these languages. All delegates were provided with tiny battery powered transistor radio receivers together with headphones by means of which they could tune in on either language. Small transmitters adjacent to the interpreter's booths fed a loop antenna strung around the conference room and this radiated enough energy to enable anyone inside the loop to pick up the signals from the interpreting booths.

Perhaps the most stimulating aspect of a meeting of this kind is the complete absence of political and social barriers. As explained by Sir Vincent de Ferranti in reply to a question by a newspaper reporter concerning the relative merit of Canadian power stations with respect to those in other countries — "we don't speak of nations when we speak about power. Power is international; no country is more clever than another country in developing power systems."

The emphasis at this meeting was, in fact, not so much upon the various techniques of power production or technical descriptions of actual plants as it was on the need for greater integration of all the different types of power supply in a particular area. The advantage of studying the development of all the energy resources of a region was stressed again and again in various ways by many speakers throughout the meeting. In this connection the question of the use of pumped storage schemes was discussed at considerable length. Here again, it was obvious that while pumped storage had great merit in many instances, there were others in which its advantages were dubious. J. K. Hunter of Great Britain, for example, pointed out that in studies made in an effort to combine irrigation with power development using pumped storage on the Nile River, the topography prevented storage from exceeding 10 to 20 per cent of the annual flow. Mr. Hunter, at the same time stressed the significance of pumped storage to the United Kingdom program involving 5000 to 6000 Mw of nuclear plant by 1965 in combination with larger and larger thermal units. He drew attention to the possibility of pumped storage based on sea water and noted the

THE WORLD POWER CONFERENCE

The World Power Conference was founded in Great Britain in 1924, upon the initiative of the late D. N. Dunlop, to form a link between different branches of power and fuel technology; between the experts of the different countries throughout the world; and between engineers on the one hand and on the other hand administrators, scientists and economists. The first World Power Conference was held in London in July 1924, the second in Berlin in 1930, and the third in Washington, D. C. in 1936. Normally, a Plenary meeting is held every six years but World War II interrupted this sequence and the fourth conference was held in London in 1950. The fifth was held in Vienna in June 1956. In addition to these main Plenary meetings, a number of sectional meetings have also been held. These sectional meetings, characterized by the meeting just held in Montreal, are devoted to limited aspects of the program of the World Power Conference.

Conferences are organized by the National Committee of the inviting country in cooperation with the Central Office in London. Participation is arranged through the National Committee in other member countries. Each National Committee normally includes representatives of Government Departments, Professional Institutions, Manufacturers' Associations, and other bodies concerned with the preparation and utilization of fuels and the generation and application of power.

The World Power Conference, however, does not confine itself to the organization of periodical Plenary and Sectional meetings. Resolutions passed at meetings are remitted to the National Committees for examination and report to the International Executive Council which decides what action shall be taken. The Central Office (in London) is entrusted with the execution of the decisions reached. The various Statistical Years Books of the WPC published from 1936 to 1956 resulted from such action.

The present membership of the World Power Conference includes 53 nations. The Conference has consultive status with the Economic and Social Council of the United Nations and is a member of the Union of International Engineering Organizations.

The present officers are as follows:

President:	Gen. Dir. Fipl. Ing, F. Holzinger (Austria)
International Executive Council:	
Chairman:	Sir Vincent de Ferranti, M.C. (Great Britain)
Honorary Chairman:	Sir Harold Hartley, G.C.V.O., C.B.E., F.R.S. (Great Britain)
Vice-Chairmen:	A. S. Pavlenko (U.S.S.R.)
	Prof. Dusan V. Velickovic (Yugoslavia)
	Major-General H. A. Young (Canada)
Secretary	C. H. Gray (Great Britain)

Fig. 3. Officers of the World Power Conference. From L to R, Gail Hathaway, Vice Chairman, U. S. A.; Sir Harold Hartley, Honorary Chairman, G.B.; Maj. Gen. H. A. Young, Vice President, Canada; Franz Holzinger, President, Austria; Sir Vincent de Ferranti, Chairman, G.B.; and C. H. Gray, Secretary General, W P. C in London

several problems which might arise from such practice. These were: Effect of salt spray from the reservoirs onto adjacent farm lands; contamination of local wells and surface streams from deep seepage of salt water through rock formation underlying the reservoirs, and finally, the possibility of chemical reaction between the salt water and the surface deposits forming the floor of the reservoir with increased permeability as possible with certain types of clay.

Combined Hydro-Thermal Systems

As summarized by Professor G. Ross Lord, the General Reporter at the first session on Hydraulic Energy, the wise planning of power systems within a country, state, or an area, calls for the utilization of wide technical experience and judgment. Some sections of the globe are endowed with abundant water power potentials while other countries lacking large water resources have available steam generating fuels. Now, the whole picture of power generation has been further expanded by the advent of nuclear fuels. Thus, system planning has become a specialized field and the papers presented at this session portrayed some of the latest techniques in different countries.

In the matter of system planning, Mr. Lord felt that a very broad and far-minded policy should be considered by the officials entrusted with this work. He illustrated his contention with what is meant by *gold mining* in Canada. A short sighted operator, bent only upon maximum returns on investment would mine out all of the high-grade ore as quickly as possible and abandon the mine within a few years. Such *high-grade* mining would leave lower grade ores underground and perhaps make them technically and economically unobtainable for all time. On the other hand, a wise operator would mine some lower grade ore and mix it with the high-grade production. In this way, a reasonable profit would be realized over a much longer period of years. In applying this idea to system planning, might it not be possible that a judicious development of higher-cost sites along with very low-cost sights might benefit a country in the long run?

Francis Admans of the Federal Power Commission (U. S.) stated that only under the most unusual circumstances is it feasible to develop hydroelectric plants for utilization in a purely hydroelectric system. The fullest and best use of hydro resources, he said, require that they be operated in combination with thermal plants. Also, some hydro sites can only be economically developed when they can be tied into a large system.

The General Reporter, in commenting on Mr. Adams' first two precepts, however, pointed out, that in many areas there might be attractive hydro resources but uneconomic fossil fuels.

Perhaps one of the most interesting examples of integrating thermal generation with hydro generation discussed at the Hydraulic Sessions, was that described in Paper 31 $A_1/2$ by Dr. Ingledow of the British Columbia Electric Co. This paper described an unattended 100,000-kw gas turbine plant under construction at Port Mann, B. C., Canada. Gas turbine plants, said Dr. Ingledow, possess a number of technical advantages over conventional steam turbine plants for *firming up* hydro, and for standby service. Gas turbines require only about 20 minutes from a cold start to full load as against 4 to 6 hours for a conventional steam plant. They require a minimum of operating personnel; in fact, they can be completely automated and controlled remotely. The Port Mann plant on the Frazer River close to the City of Vancouver will comprise four Brown Boveri 25,000-kw double shaft open cycle gas turbines with one stage of intercooling between the high and low pressure compressors. When completed later this year, this will be the largest gas turbine plant in the world. It will feed into the 230-kv system and will be completely unattended, the units being started, loaded, unloaded, and stopped from the system load dispatch office.

Power from Coal, Oil, and Gas]

Despite the vast amount of hydroelectric development throughout the world, the bulk of the power used is still derived from fossil fuels of one kind or another. The rapid and continuing increase in world population

Fig 4. A. S. Pavlenko, chief Russian delegate Minister of Power Stations, USSR

Fig. 5. K. M. Irwin, Chairman of the United States National Committee

Fig. 6. Getting ready for registration just before the meeting

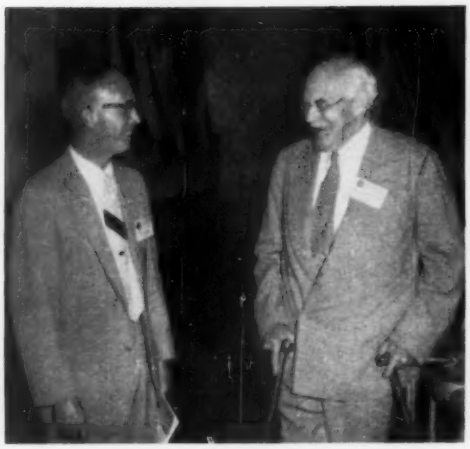


Fig. 7. Andy Kramer chatting with Honorary Chairman Sir Harold Hartley between sessions

and the rising demand for higher standards of living is making unprecedented inroads on these available stores of energy, but inevitably they will become scarcer. As Professor E. A. Allcut, the Reporter at the first session on thermal energy, expressed it, at present it seems unlikely that much of this demand can be provided from *income* because the probable contributions of sources such as water power, solar energy, winds and tides, are comparatively small, despite their importance in certain areas. Since the fossilized fuels will be the main standby for some years to come, and as these are not replaceable they will invetably become scarcer and more expensive.

The 12 papers on this subject presented at the Conference from nine different countries and four continents were highly diversified in character; some of them dealing principally with the extent and character of the fuel resources in the regions concerned and others with various fields of specialization, making it difficult to present a composite picture of the general situation. One thing was quite apparent, however, and that was the greater emphasis throughout the world on developing techniques for burning lower grade coals and lignites. Professor A. G. Christie (U. S.), and others, pointed out that high moisture content is no longer a serious problem if the coal is burned in pulverized form, and provided that high air preheat is used. With certain lignites adequate ventilation is necessary to avoid overheating of the coal in storage. Several speakers mentioned the steadily increasing percentages of ash which necessitates the use of coal in the pulverized form, preferably in large boiler furnaces. Professor Christie noted that in Russia coal with an ash content of as high as 60 per cent was being burned successfully.

With regard to Russian power development, Mr. Pavlenko, the Minister of Power Stations in the USSR discussed the recent change in plans for their future power development. While the USSR's hydro potential was enormous, they were now embarked on a program for the more rapid development of a greater number of large thermal stations, since the construction of large hydroelectric projects involves too much time. This does not mean that the USSR is abandoning its long range hydro plans, merely that for the present, greater emphasis will be placed on thermal plant construction. P. A. Rozenko of the USSR, who spoke excellent English, explained that Russia had about 30 deposits of different coals, lignites. The maximum economic radius of fuel transport in Russia, he stated, was around 2000 km. In many cases high grade fuels were delivered into areas possessing low grade deposits.

The papers presented at the session on the design and operation of thermal stations reflected the universal and international desire to reduce the cost of heat and power. Western Europe, said Dean D. L. Mordell of McGill University who was the reporter for this session, probably faces the most difficult situation because, there, the supply of good fossil fuels is diminishing, and the cost increasing, at a time when the rate of growth of power demands seems likely to surpass the rate of evolution and development of power plants capable of using fissionable fuels.

Apart from cheaper fuels, we improve matters by using it more efficiently, and Paper 35 B$_4$/4, presented by Dr. P. Profos of Winterthur, studied and evaluated cycles using supercritical pressures and one and two stages of reheat. The performance of a 250-Mw plant operating at 4350 psi, with steam at the turbine inlet at 1112 F and reheating to 1049 F, was illustrated as an indication of what might lie ahead. Paper 111 B$_4$/5, therefore, was particularly valuable since it evaluated the experience gained in the first supercritical, double reheat, system at the Philo plant in the U. S. In this paper, Sporn and Fiala indicated that an increase in steam temperature above 1050 F was not economic at the present time due to the cost of the large amounts of austenitic steel required. It was of interest to learn that in spite of the feed pump trouble experienced with Philo No. 6, it is proposed to use single pumps for the new 450 Mw units, driven by a separate 15 Mw condensing turbine.

Clever Gadget

. . . . a considerable amount of North America's present inordinately high power is found in the cleverest gadget ever invented by man—next to wars—for the waste of mineral resources, the gadget which individual Americans are so *unwisely* proud of—you guessed it: the gasoline automobile. Indeed, peace is more dangerous than war for America—more Americans being killed by all accidents each year than the maximum casualties we have had in any war . . . the American economy, built in the past and run today on the assumption that we will always have natural resources to waste, is bound up with the automobile. America could have a higher standard of living *without* a 1-hour-a-day car in every garage. . . . With the United States now dependent on imports for one-fourth of its iron ore, and the country importing an average of 1½ million barrels of crude oil and products every 24 hours the year 'round, this profligate prosperity would be headed for a come-down for this reason alone, if other technological factors did not have even more explosive impact.

From a discussion by John A. Waring before the World Power Conference in Montreal

Fig. 8. World Power Conference members visit one of Canada's hydro plants

The pressing problem in large generator construction is cooling, and in the Philo unit hollow conductors are used with gas cooling. Paper 53 $B_s/3$, presented by Professor Heller (Hungary), considered the economics of improving the effectiveness of gas cooling by employing refrigeration to produce a lower air temperature than could otherwise be obtained from available cooling water. Essential for this method, of course, was the use of a refrigeration plant which could be realized with little cost and the operating costs of which would be low as well. Furthermore, the plant should be simple and not impose a special task for the staff of the station.

The solution which completely fulfilled these conditions, is a system using a steam jet refrigerating plant and bleeding the steam needed for it from the turbine, while the condenser of the installation is the condenser of the turbine itself.

In the discussion of these papers, several delegates referred to Sporn's statement that steam temperatures above 1050 F are not justified in any size plant at present. Sir Christopher Hinton was of the opinion that while Sporn had had to back down from 1150 F to 1050 F, it was only a temporary halt in the trend toward higher temperatures. He felt that in the future, metallurgists will develop material to withstand higher temperatures and at the same time, be cheap enough to justify its use. We might be able to design stations to reduce the amount of high cost materials to a minimum; in fact, Sir Christopher suggested that it might be possible to build a completely integrated power station controlled by only a single valve, with electronic control for boiler feed pumps, combustion, etc.

Nuclear Energy

As might have been expected, the Nuclear session, presided over by Sir Christopher Hinton, General Chairman of the Electricity Board of England, was perhaps the most important technical feature of the Conference, because, as Sir Christopher expressed it, "it covers the newest and perhaps the most exciting of all the recent developments in the power plant industry." Twelve papers were presented at this session, three by British delegates, two each by U. S., Canada, Sweden, and France, and one by Western Germany. For Great Britain, Sir Christopher Hinton and L. Rotherham reviewed the operational history of Calder Hall, while J. A. Jukes and J. K. Wright discussed the Economics of Nuclear Fuels. Trends in the design of large British Nuclear Stations were discussed by H. West and A. L. Shaw. While the startup of Calder Hall was smooth and without incident, subsequent operation indicated a need in a change in design philosophy. Engineering development of basic design has led to greater size and efficiency in the nuclear stations now on order. Despite these advances, however, the long term future depends on the use of higher temperatures.

The papers at the nuclear session could be divided into three groups; first, those concerned with economic aspects of nuclear power; second, those dealing with the supply and transportation of fissionable materials; and third, those concerned with trends in plant design.

In discussing the economics of uranium and thorium, W. B. Lewis of Canada pointed to the large production of uranium referred to in a paper by Barrett and Thunaes, also of Canada. Such large production, Lewis said, has led to concern regarding the future requirements of uranium. Only a few years ago there was serious talk of the prospect that economically available supplies of uranium and thorium might restrict the development of nuclear power. Now the position is reversed, and the state of technical development of nuclear power threatens to restrict the market for the abundant supply of these materials. In order to forecast the rate of application in North America, Lewis estimated the cost of power from four reactor types: pressurized water, dual cycle, gas-cooled graphite, and heavy water. Applying 4 per cent interest to inventories of expensive materials, and 10 per cent capital charges on fixed plant, Lewis derived costs of more than 8 mills per kwh for the first three and about 6 mills per kwh for the last. From these figures, Lewis was of the opinion that the first three will not claim much of the electricity market in North America unless costs can be reduced, and that in the long run, none of the first three types would be likely to compete with heavy-water moderated reactors. Others, however, disagreed with some of the data used by Lewis. Kennedy and Henderson (GB) said that the latest UK plants are expected to cost less than the capital costs assumed in the comparison, and they questioned the cost of fuel and financing.

Donald Stewart presented the economic side of nuclear power for the U. S. The U. S. has the largest and most varied experience with reactors and this formed the basis of Stewart's paper. He listed 9 reactors which have produced electricity, including Shippingport. Many designers consider that enrichment can be used to lower capital costs appreciably, e.g., by permitting a larger ratio of sheath to fuel and, therefore, higher specific powers. The annual fixed charges are so high for private financing that the capital savings may outweigh the extra fuel costs for enrichment, and Stewart questioned whether natural uranium reactors can become important in the United States except through government financing.

Because nuclear power is characterized by high capital costs and low operating costs, if it is to be economic it must be used at a high load factor. This poses special problems regarding the integration of this type of plant into existing systems. The Swedish delegates stated that their country's engineers had made a careful study of this in relation to the power requirements of their country. In addition to the production of electrical energy, Sweden is planning to use nuclear energy for central heating and is constructing two plants.

Transportation of Energy

While the production of power from various energy sources together with the integration of the different systems occupied most of the technical discussion at the Montreal Conference, a substantial amount of time and attention was given to the problem of transporting energy. This involved electric transmission, transportation of fuels by rail and water,

and transportation of fuels by pipeline. The ten papers presented at the Electric Transmission session covered a wide range of economic factors and only certain aspects could be considered in the discussion of these papers.

D. P. Sayers, in describing the electrical transmission system of Great Britain, stated the cost of transmitting power a distance of around 100 miles is about 10 per cent of the cost of generation. The backbone of England's transmission system is a 275-kv grid by means of which bulk power is transmitted from the generating centers near coal mines to the load centers of the big cities. Nearly all of these 275-kv lines, Mr. Sayer pointed out, are designed for ultimate operation at 380 kv. The 275-kv circuits now running from the midlands to the London area, he stated, now have a capacity of about 1000 Mva but at the higher voltage they will be able to carry 1500 Mva.

An interesting fact brought out by G. D. Lloyd of Canada, involved his opinion that most transmission lines can be operated satisfactorily at higher voltages than those they are designed for. As an example, he cited the operation of their rural distribution lines, which had been designed for 4000 v, at 8000 v with perfectly satisfactory results. Another case involved one of two 115-kv lines which was modified to operate at 230 kv by adding two suspension insulators to each string but no change was made in the conductor spacing. No trouble was experienced. Most lines are designed very conservatively, said Mr. Lloyd, and he felt that their own 230-kv lines could be operated satisfactorily at 345 kv.

With respect to extra high voltage transmission, F. Petri of Sweden stated that in their studies involving transmission lines extending from the hydro stations in the north to the load centers in the south, the use of 600 kv instead of the 400 kv actually used showed a saving of only 4 per cent and for 500 kv even less.

There is an increasing awareness of the possibility of economies in the transmission of electrical energy by direct current. Although much of the work on d-c transmission is in the study and research stage, the existing installations have provided much useful knowledge.

Much of the discussion involved the relative economics of transmitting energy electrically as compared to transporting fuel by rail, water, or pipeline. Studies indicate that, in general, it is more economical to locate the thermal plant adjacent to the source of fuel and to transport the electrical energy to the area of use. One delegate observed that in Britain the transportation of electricity is cheaper than the transportation of coal by rail above a critical distance of approximately 50 to 70 miles, and that this is directly opposite to the situation in the U. S. Again, a French delegate reported that in France a specific study indicated that it was preferable to transport the coal. It is quite evident, therefore, that local problems and national economy must be carefully considered in any study of this vital problem.

As a matter of fact, the problem is extremely involved and factors other than economics enter into the picture. In England there is a growing sensitivity on the part of the public to the erection of overhead transmission lines. Mr. F. J. Lane (GB), in discussing this question, said that where a station is located near the mines and power transported electrically, the cost of getting the coal into the generating station, often is not taken into account. This may amount to as much as 20 cents per ton.

From a broad standpoint, Mr. Lane said, a transmission system is more than a means of transporting energy; it is a means for integrating the variable load factors of the different generating stations. Also, it is a means of utilizing the economic balance of the various generating units of a system.

While only four papers were presented on pipeline transportation of fuel, the discussion of these papers was stimulating and reflected the difficulty of evaluating the economics of this type of transport. Pipeline transportation has been used for oil and gas for many years, and more recently it has been used for the long distance transport of coal, mixed with water as a carrier. The need for some of these pipelines has been obvious because nature has provided her gifts of solid, liquid, and gaseous fuels in places far distant from the man-made centers of large consumption. Some of the transportation possibilities, however, are not so obvious, and great care must be taken to see that each project is not only successful, practically, but also has a proper chance of being financially successful.

Fig. 9. Small battery operated transistor radio receivers were used to pick up conference proceedings in two languages, broadcast from a loop antenna strung around the room

Utilization of Energy

A great deal is known and much has been written about the production of energy and the means whereby it can be transported, but comparatively little attention has been given to the utilization of energy. Yet, as indicated by one of the General Reporters at the utilization sessions, it is the demand, even more than the supply, which has provided the real dynamic influence for development in the industries.

At the Conference there were two sessions devoted to Utilization, one concerned with Industrial and Commercial Utilization and the other with Farm and Residential Utilization of Energy. Naturally, the problems in the utilization of energy are extremely diverse, and no detailed analysis of the discussion can be given in this brief report. One thing, however, was very obvious and that is that the opportunities for savings are much greater in the utilization field than in the generating division of the field. Whereas turbine and generator designers spend untold effort in attaining improvements in efficiency of the order of a fraction of a per cent savings of 10 to 25 per cent are possible in the utilization of energy. This was illustrated by one of the Russian delegates, who described how they had reduced the amount of power required in the petroleum industry by a systematic study of all power using equipment. Before this study was made they found that over 50 per cent of the oil output of a refinery was used in the petroleum industry itself. THE END

WORLD POWER CONFERENCE · CANADA 1958 · WORLD POWER CONFERENCE

Geneva Prestige Package Describes American Nuclear Technology

AN IMPORTANT feature of the United States Government's contribution to the Second International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1 to 13, was the presentation to United Nations officials, of sets of a 13-volume "prestige package" of technical books on American nuclear science. The presentation was made on September 3 by Lewis L. Strauss, Chairman of the United States Delegation to the Conference. The volumes were accepted on behalf of the U. N. by Dr. Ralph J. Bunche, Under-Secretary for Special Political Affairs. In making the presentation, Mr. Strauss said that the United States will also present complete sets of the 13 volumes to the principal representatives of each country participating in the conference.

Written by a group of America's most distinguished scientists, these 13 volumes contain virtually the complete United States nuclear technology on the non-military applications of nuclear energy. They are hard-bound volumes in uniform binding, averaging around 500 pages each. Included in the list of titles are the following: Project Sherwood — The U. S. Program in Controlled Fusion; Research Reactor Operation and Use; Radiation Biology and Medicine; Solid Fuel Reactors; Fluid Fuel Reactors; Boiling Water Reactors; Physical Metallurgy of Uranium; The Transuranium Elements, Sodium-Graphite Reactors, Uranian Ore Processing, Thorium Production Technology, Shippingport Pressurized Water Reactor, and Physical Theory of Neutron Chain Reactors.

The publisher selected for this project was the Addison-Wesley Publishing Co of Reading, Massachusetts.

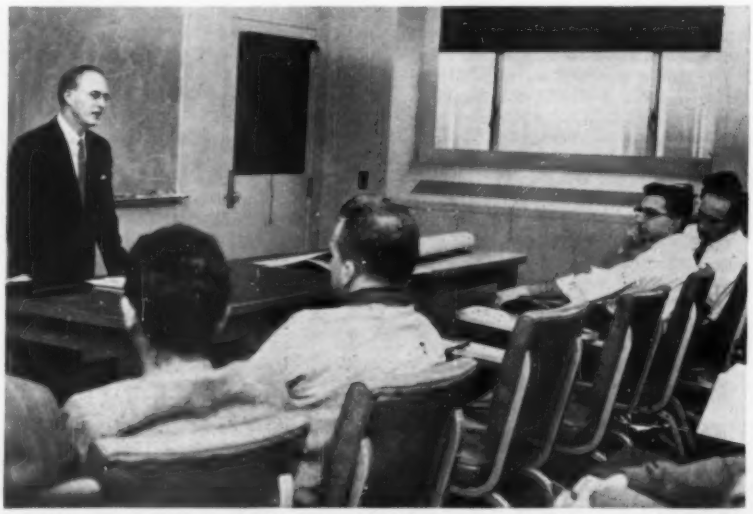
Among the more important of these books is the one on Boiling Water Reactor Systems, which was written by Andrew W. Kramer, Editor of the ATOMICS section of POWER ENGINEERING, and Technical Assistant to the President of Technical Publishing Co. Because of his enthusiastic and sustained interest in the field of nuclear energy, Andy was retained as a special consultant by Argonne National Laboratory to prepare this book. Since the Boiling Water Reactor is uniquely the contribution to nuclear technology of the Argonne National Laboratory, it is fitting that this volume was prepared under the auspices of Argonne, and with the assistance and coöperation of its many scientists and engineers.

Starting this huge task just about the last week in March, Andy worked literally night and day for three months writing this 560-page book in order to meet the June 15 deadline. Before the actual writing could begin, he had to travel from Vallecitos in California to General Nuclear Corporation in Florida to get preliminary facts. Then, working at Argonne, under Dr. Hoylande Young, Director of the Technical Information Division at Argonne, he had at his disposal virtually the entire resources of that department for source material. As a consequence, Kramer's book is authentic and reflects the thinking and philosophy of the highest and most competent authorities in the field.

The purpose of Kramer's book is to describe what is known about boiling water reactors for the practicing engineer who is already familiar with the basic principles of reactor technology in general but who has not had the opportunity to study boiling reactor systems in detail. The boiling reactor is somewhat unique in that its physical simplicity belies the complexities of its operation. Because boiling reactors involve the use of a liquid and vapor phase mixture, with each of the phases having different and varying neutron, thermal, and hydrodynamic characteristics, the theory of this class of reactors is more complex and difficult to understand than that of reactor types using single phase coolants and moderators. It is only recently that the interrelationships of these varying parameters in boiling reactor operation are beginning to be understood, and that reactor designers have learned how to use them in predicting boiler reactor performance.

With the publication of "Boiling Water Reactors", Andy has added another distinguished volume to the half dozen he has written since 1930, mostly in the fields of electricity, electronics and power production. He possesses many unusual qualifications that particularly fit him for writing about nuclear power technology: an engineering education, his practical experience as electrical engineer with utility and manufacturing organizations, his many years of technical writing as Editor of POWER ENGINEERING, and more recently, his extensive writing in the field of nuclear energy as Editor of ATOMICS.

His professional affiliations are many, including, among others, Life membership in the American Institute of Electrical Engineers, membership in the Institute of Radio Engineers, the American Society of Mechanical Engineers, and the American Nuclear Society. He has been a member of the Advisory Committee on Industrial Information, U. S. Atomic Energy Commission since 1953, and was a member of the first Atomic Bomb Test Expedition to Bikini in 1946. Interested and active in Amateur Radio since 1911, Kramer has been a member of the American Radio League for many years and has operated Amateur Station W9CPV since 1920. His other avocation is mountain climbing, and he is a member of the Alpine Club of Canada, and the American Alpine Club.



A. W. Kramer, Editor of ATOMICS, and author of one of the Geneva Presentation Volumes, shown here as guest lecturer at Argonne National Laboratory

Three Years' Field Testing Proves New Scale-Removal Method

Pilot tests on Republic Steel Co boiler show method to be safe, simple and effective in scale removal and prevention, in boilers as well as other heat exchangers. Downtime is cut considerably

Editor's Note: Stories of truly vital and significant development in the power field are rare items, even in an age when yesterday's innovation is tomorrow's obsolescence. This, we think, is such a story. It is with satisfaction that we present, for the first time anywhere, the case history of a new product development that promises to completely revolutionize the cleaning of high makeup industrial boilers by chemical process.

Our pride in having a part in this development is, we think, pardonable for several reasons. First, the story accents with crystal clarity the many thousands of miles traveled each year by your editors to keep abreast of research and development in the field. Second, while technical magazines must of necessity be edited months ahead of publication, this awareness of what's new in the field enabled us to present this first case-history to our readers within a matter of days after The Dow Chemical Co made public their announcement of the product.

"Versene," says the Dow release, "is a product which opens up a new technique for the chemical cleaning of industrial boilers using a high percentage of make-up water, reduces downtime for the cleaning period by as much as thirty hours and results in a monetary saving of as much as 65 per cent."

What impressed your editors even more than this, however, was the do-it-yourself aspects of the application which completely eliminates the necessity for large acid trucks, portable pumping equipment and large technical field staffs. Even more important was the elimination of the necessity for critically rigid temperature control requirements associated with the use of acid inhibitors. If you would like more information on this new technique, the editors will welcome your inquiries.

By JOHN J. ALEXANDER *

IN STEEL, as in most other industries, electric power and steam are essential to full production. This leads us to schedule our power plant maintenance requirements for the minimum effect on the production department. As production increases, time available for scheduled maintenance becomes more limited.

Our problems, therefore, are multiplied. We must schedule more work in less time, and hold costs to the lowest practical level. This means continually searching for new means to improve our performance.

In at least one area, the cleaning of our boilers, we have apparently achieved a major breakthrough. This consists of a method of chemical cleaning using a chelating agent for the removal of scale and sludge. We have found this to be much quicker, more efficient, and easier to handle than other means, as well as completely safe for both men and equipment. This method has also proved to be extremely economical.

In Cleveland District Power Plant No. 1, we have three Babcock & Wilcox two-drum Stirling boilers, rated at 220,000 lb per hr, 900 psig, 850 F (See Fig. 2). These can be fired with any combination of blast-furnace gas, coke-oven gas, and/or pulverized coal. During normal operation they are operated at 250,000 lb per hr each.

Steam from these boilers is used by a 10,000-hp topping-turbine-driven blast-furnace blower, and a 20,000-kw 60-cycle 11,000-volt non-condensing turbine-generator unit. Both exhaust into our 240-psig steam system, supplying steam for four 25-cycle condensing turbine-generators totaling 27,000 kw. There are also two condensing turbine-driven blowers supplied from the 240-psig header.

All of these units are operated at base load to utilize as fully as possible the by-product gases. Power generation is about 60 per cent of our monthly consumption, and 40 per cent of our peak demand. The 25- and 60-cycle systems are tied together through a 10,000-kw frequency changer, which automatically carries load from one system to the other. It can change from its maximum capacity in one direction to the same in the other as the demand changes.

*Superintendent of Power and Steam, Cleveland District, Republic Steel Co

Since in the event of a boiler outage, steel production must be curtailed, it is imperative that maintenance be such that emergency outages are kept at a minimum. Further, it is necessary that our scheduled outages be planned to coincide with cut-backs in production, such as holidays and the Christmas season. During these outages a great deal of work must be accomplished quickly and efficiently. Cleaning of the boilers was always one of the most time-consuming jobs, most difficult with only a 48 to 72 hour outage.

History of the Boilers

Our first two boilers, A and B, were installed in 1951. Boiler A was acid-cleaned for the removal of mill scale before entering service in July. Boiler B, however, was not acid-cleaned until it had been in service six months, in January, 1952.

During this latter cleaning, it was found that the mill scale removal was more effective after the boiler had been in service for several months. Sludge detected at this time was tested, and found to be 90 per cent tricalcium phosphate, 5 per cent magnetic iron oxide, and 5 per cent suspended matter.

During the period between 1952 and 1956, we operated a continuous blow-down from the steam drum. Blow-down of the mud drum took place every four hours, maintaining dissolved solids at 1200 ppm.

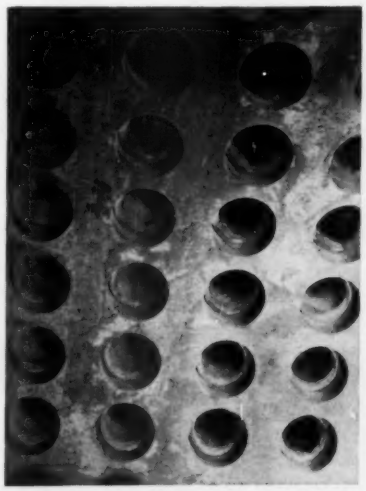


Fig. 1. Scale deposits before cleaning

Following that period of operation, the dissolved solids were gradually raised (100 ppm every six months) until a level of 1500 ppm was reached. Operation now continues at that level, with most satisfactory results.

Boiler C was put into operation in 1957, and has not yet been cleaned by any method.

During the period from 1952 to 1955 acid-cleaning was not needed, it being only necessary to jet lance the down-comers and steam-generation tubes.

Water Treatment

Since make-up normally runs from 40 to 60 per cent, and can run as high as 80, a treatment plant of considerable proportions is required. Ours has a capacity of 750,000 lb per hr. It consists of a hot-lime treatment, reducing hardness from 120 ppm to 60, followed by anthracite filters, and hot zeolite, which reduces the hardness to 1–2 ppm. Source of the water is municipal.

Boiler feedwater is treated with continual injection of disodium phosphate and organics and sodium sulphite as required. This is accomplished by three high-pressure chemical-feed pumps which can be used to feed the boilers separately if so desired.

Boiler Cleaning Required

When it became apparent that the time for further boiler cleaning was approaching, we began to re-investigate all of the various possibilities. Mechanical cleaning, in addition to being time-consuming, presented serious difficulties due to the shape of the swaged tubes, which are smaller at the ends than through the length of the tube. It also consumes an almost prohibitive amount of time.

Acid cleaning was time-consuming too, due to the necessity of cooling and draining the boiler previous to the injection of the acid, and draining, filling and neutralizing the boiler afterwards. Delicate controlling of temperature and water level, and replacing of gaskets, were drawbacks.

It was then that we learned about the method of cleaning that we are now using. It consists of the use of chelating agents introduced into the boiler as a water solution. Through a series of applications we have improved our technique so that the results to date are quite satisfactory.

Our first cleaning was in Boiler A in December, 1955, when we made the application using Versene[1] 100 alone. The procedure consisted of introducing sufficient chelating agent into the boiler, after the pressure had been reduced to 150 psig, to result in a 1.2 per cent solution of Na_4EDTA.

Intermittent boiling was continued at approximately this pressure until the reaction of the Versene with the scale components was apparently complete. In this case, the pH was maintained at 10 or above by the periodic addition of caustic soda. Approximately 18 hours were required for this operation.

A study of the economics involved in the use of cleaning with chelating agents in comparison with the cost of normal methods indicated a savings of 65 per cent.

In December, 1956 we took Boiler A down again, draining and inspecting at that time. The mud drum, steam drum and visible tubes revealed about one-half the quantity of sludge which we found previously.

Inspection Results

Apatite sludge in the drums was not of its ordinarily tenacious variety on this inspection, and much of it was flushed out by hosing down. After flushing, there remained between 1/32 to 1/16-in. sludge on the drum surfaces, with a somewhat heavier deposit in the tubes.

Physical change in the sludge, in our opinion, was due to the previous cleaning with Versene 100 in which some residual or delayed action took place. In support of this fact was the muddy quality of the blow-down water about a week following the first chemical cleaning with Na_4EDTA. There was 0.010 to 0.020-in. sludge on drum surfaces and up to 1/32-in. sludge in tubes on inspection following this cleaning.

It seems reasonable to assume that the physical make-up of the sludge was so altered that, although it was not removed during the trial itself, a portion of it was gradually sloughed after the system went back in operation. This may have been due to the higher velocity of the water circulating through the tubes.

At this time we gave Boiler A its second cleaning by this chemical method. For this trial, an original pH of between 7.5 and 8.0 was used, which rose gradually as the reaction proceeded.

Chelating agent solutions with a pH of approximately 7.8 were made up in 100-gal batches, using H_4EDTA to neutralize the water solution of

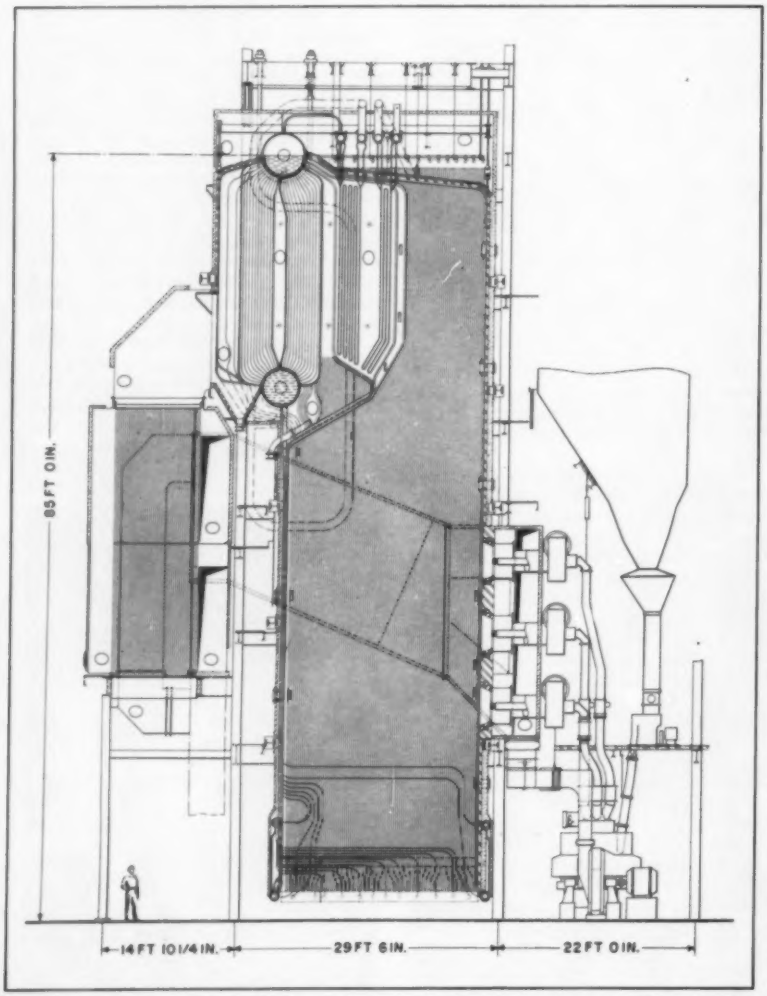


Fig. 2. Cross-section of the boiler. Natural circulation aids in effective cleaning

[1] Registered trademark of The Dow Chemical Company. Versene 100 is a water solution of ethylenediaminetetraacetic, tetrasodium salt (abbreviated Na_4EDTA).

Na_4EDTA. The resulting mixture was pumped through the chemical-feed lines to the boiler system. For the trial, the boiler was filled with 18,000 gallons of condensate at a pH of 7.1.

First loading used four drums of Versene 100 and 300 lb of Versene Acid.[2] This resulted in a concentration of 0.68 per cent Na_4EDTA. Later in the trial a further addition of one drum of Versene 100 and 50 lb of Versene acid was made to give a total of 0.91 per cent Na_4EDTA.

Periodic titrations were made for available chelating agent, and pH and phosphate concentration.

Comparing the results of the 1956 cleaning with those of the previous year, when we used the highly-alkaline conditions, it was apparent that the chelating agent-apatite reaction proceeded at a greater rate and went further to completion. Although there was a residual of unreacted chelating agent in the system, it was less than that experienced in previous trials.

One important advantage of this method of cleaning became apparent. When the chelating agents were introduced into the steam drum, the natural circulation, which was in effect as a result of the periodic firing of the boiler, carried the highest concentration down the down-comers and through the mud drum in exactly the pattern where the greatest amount of cleaning was needed. This assured maximum effectiveness.

The use of condensate in this test was purely experimental. As no particular benefit was observed, we shall next time merely bring the boiler down to 150 psig, as we did in the first test, and begin our treatment.

Visual inspection following the second application of Versene to Boiler A showed the tubes to be between 80 and 90 per cent clean. Assuming we got a delayed action as we did on the first chemical application, more sludge was sloughed off after the boiler was put back on the line.

It is my opinion that if you get a metal clean surface you do not redeposit scale as rapidly as you do with a partially-cleaned surface. When you leave ridges and scale here and there you get a quicker redeposit. As a result of work to date, we conclude that the following advantages can be expected from use of chelating agents to clean boilers:

1. No corrosion of iron and steel due to cleaning of surfaces.

2. Boiler does not need to be completely cooled before introduction of cleaning solution.

3. Higher cleaning temperatures possible with safety, making possible natural circulation rather than depending on external circulation pumps.

4. Residual cleaning action during operation, thus reducing the amount of scale build-up, so that there is less to be removed at the next cleaning.

5. Greater safety during handling of materials.

6. No dangerous fumes or vapors to be vented.

7. Fewer gaskets to be replaced.

8. More economical than other methods in most cases, considering overall costs of cleaning.

During 1958, all three of our boilers were opened, and found in excellent condition. Boiler A was inspected in August, and the mud drum and water tubes were clean, with only a powdery gray film about egg-shell thickness, merely a discoloration of the metal surface.

Boiler B was inspected in March, 1958, and found to have a soft, non-adherent sludge in the mud drum. After hose down, the tubes showed no more than a ½-in. deposition.

It is our opinion, therefore, that the chelating agents have performed in accordance with our expectations. While we are not certain as to when the next cleaning will be required, we expect to repeat our use of the method. For this purpose we have the necessary chemicals on hand when opening any one of our three boilers. THE END

[2] Versene acid is ethylenediaminetetraacetic acid (abbreviated H_4EDTA).

About the Author

Superintendent of Steam and Power is a job that keeps John J. Alexander, shown here with Wayne Merriman (c) and Paul Sutton (r), Dow Chemical engineers, moving about extensive divisional operations of Republic Steel Corporation 40 per cent of his time. One week he may be supervising power plant operations at the Cleveland (home base) works, while the next week he may be inpecting or consulting at company operations in Alabama, or visiting the new Reserve Mining Company taconite reduction mill up along the shores of Lake Superior in Minnesota.

Alexander gets a slight twinkle in his eyes as he recalls his various steps from the day he was graduated from University of North Carolina in 1930 with a B.S. in electrical engineering. He first worked for American Telephone and Telegraph as an engineer trainee. This period included transmission and toll line work in the Southern Division.

In 1933, he went with Florida Power and Light Company as substation operator. Subsequent assignments as statistician, as betterment engineer at the Lauderdale Steam Electric Plant, the system's largest station, and later as unofficial assistant superintendent.

Alexander began his work for Republic Steel in October, 1941 as test engineer. He was advanced to assistant superintendent of the Power and Steam Department in 1943 and became superintendent in 1951.

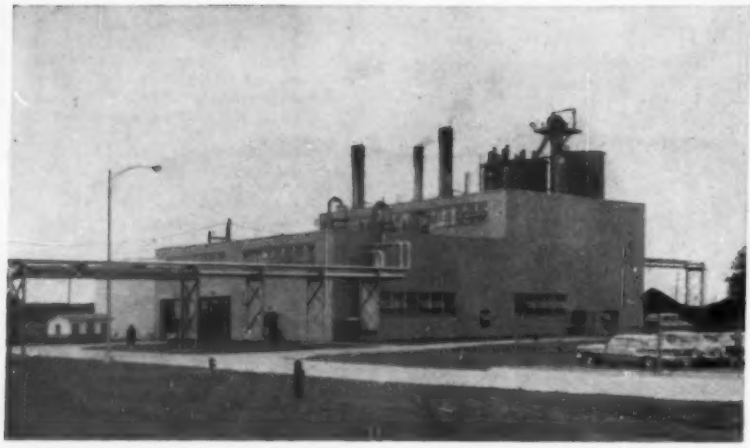
In 1946, he was awarded the J. E. Johnson Award for his contribution to blast-furnace progress. He was first to set up two blowers in series on the first high-top-pressure furnace. He now supervises power plants in the Cleveland District and acts as consultant to Republic Steel's other districts.

Alexander is a member of American Iron and Steel Engineers, Blast Furnace and Coke Association, and American Society of Naval Architects and Marine Engineers.

Tabulation of data taken during second cleaning of Boiler A

Log of Cleaning of Boiler A, December 13, 1956

Time	% Na_4EDTA available	pH	P_2O_5 (ppm)	psig
(theoretical)	(0.68)	(7.1–7.8)	——	——
6:00 pm	Chemical addition started			
8:00 pm	Addition of 18,000 gal of condensate completed			
8:30 pm	Fires started			
9:00 pm	Chemical addition completed			
9:40 pm	0.39	9.0	6	10
10:00 pm	0.20	9.0	530	——
10:40 pm	0.17	9.2	700	50
11:00 pm	0.16	9.4	775	75
11:30 pm	——	9.5	750	——
12:00 mid	——	9.9	695	125
12:30 am	0.13	10.3	664	170
1:00 am	Boiler blown down 10 in.			
1:20 am	All make-up water in			
1:45 am	0.09	10.5	575	138
4:30 am	Additional chelating agent added			
4:40 am	0.19	9.6	595	——
5:00 am	0.20	9.5	655	——
5:30 am	0.20	9.5	723	140
6:00 am	0.19	9.7	700	——
7:00 am	Boiler drained for inspection			



Figs. 1 & 2. Power plant as viewed from main building, and close-up of the seven steam, air and gas lines in overhead crossing. Water is underground

At Automatic Electric, A Necessity: Efficient Power Engineering

WITH NO LESS THAN 23 building-wide central piping systems, a power plant capable of furnishing 120,000 lb per hr of 190-psig steam, private wells supplying plant water needs at the rate of over 1,000,000 gpd, and the electrical load of a young city (including 35 miles of fluorescent tubes), the new plant of Automatic Electric Co is an impressive challenge to any power engineer.

Visitors are impressed with the immense size of the plant, but until many hours have been spent exploring the intricacies of serving the 1,520,000 sq ft (35.35 acres) of floor space, the actual problems cannot be realized.

Built in 1957 on the 167-acre site of a golf course in suburban Northlake, 15 miles from Chicago's loop, the plant employs some 8000 people in the manufacture of telephones and related equipment. All of the manufacturing area is one-story, while the office space is housed in a two-story section. Only the power plant is a separate building.

Power Plant

In the boiler plant, two 50,000-lb-per-hr and one 23,000-lb-per-hr stoker-fired boilers furnish 190-psig steam for heating and process needs. From the coal pile in the rear of the car-unloading pit, a bucket conveyor hoists the coal into either of the 200-ton silos. An ash silo of 50-ton capacity is also provided.

Interesting arrangement of the air-compressors is a feature of the power plant. Due to wide variation in the demand for compressed air, five cylinders are operated in parallel, cutting in and out automatically. There are two 300-hp two-cylinder units, and one 150-hp single-cylinder unit. The 300-hp motors are operated at 4160 volts. Air pressure is 105 psig.

Water Supply

Originally the wells at the plant were drilled to 1928 ft, at which level there was a virtually-unlimited water supply. It was found, however, that this water was extremely hard (53 grains), and would have required an extensive demineralization installation.

It was therefore decided to back-fill the wells to 1500 ft, and when this was done, an apparently-sufficient supply of 15-grain water was obtained. Water requirements of the plant are over 1,000,000 gpd, and the present pumps are rated at 1000 gpm each, will pump 1250 gpm or more. The two wells are 800 ft apart. Twice-weekly water table readings reveal little change from the static level of around 500 ft.

Procedure of back-filling the wells consisted of raising the pumps, and filling the well-casing with cement to the desired level. It was found that the cement set very rapidly, and no difficulty was encountered in the entire operation. After the 1500-ft level was reached, the side-walls of the casing were blown out, the pump lowered to the desired level, and operation resumed.

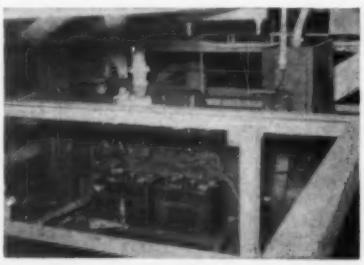


Fig. 3. Hidden high in the truss area are five of these emergency generators

Water storage facilities consist of a 250,000-gal, 130-ft-high spherical tank, divided into two halves, one for fire, the other for domestic use, and a 400,000-gal general service tank at ground level.

Automatic Lawn-Watering

Another water source is used for the extensive underground lawn-watering system. Of the 25 acres watered, 20 acres are completely automatic. The remainder is covered by a conventional system in which the sprinkler heads are plugged in manually.

The 800 sprinkler heads in the automatic system are arranged in 10 zones. At six o'clock each evening, a time clock starts the sequential watering. Humistats which measure the conductivity of the earth between a point ½ in. below the surface and a point 3 in. below the surface, control whether or not a zone is watered, and how long it is watered. After each zone is moistened to the proper degree, the time clock seeks the next zone, and the process is repeated. This is continued until all zones have been watered, or until six a.m.

Water for lawn watering is taken from a pond in a creek which flows through the property, by a 400-gpm pump. Besides the creek source, this pond is replenished by roof drains and, if necessary, by a small shallow well. It is interesting to note that the system has been designed with no overlap of zones (or sidewalks), but that 1 ft of overspray will occur per 1 mph of wind.

Only a small amount of water is

Fig. 4. Ash silo on left, and two coal silos, with vacuum and bucket conveyors

Fig. 5. Boiler room is clean, modern, efficient. View of stokers and controls

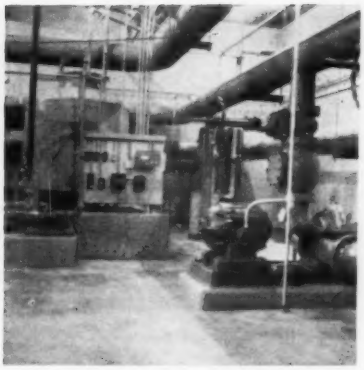


Fig. 6. Tanks, pumps and equipment for automatic aircon cooling-water treating

taken by the plant from the municipal system of the village of Northlake. This is used in the plating department, and will be discontinued as soon as a new demineralizer, now being installed, is ready for use.

Central Systems

Handling of all lubricants at the plant is by the central-system method. Eight separate systems, each complete with unloading and circulating pumps, are used. The pumps are in a pump room along the north wall of the building, and the tanks, ranging up to 5000 gal, are buried outside at that location. Arrangement of these systems is such that any combination of the systems may be filled simultaneously, each without interference with any other.

Two very similar systems are used for the receiving and dispensing of muriatic and sulfuric acid.

A most unusual system of soap dispensing is employed at Automatic Electric. From the fan room on the third floor — the highest place in the building — liquid soap flows by gravity to hundreds of dispensers in washrooms throughout the building. After numerous attempts, a soap which would flow without clogging was discovered, and, in spite of the fact that drainage is directly from four 55-gal drums which are open to the atmosphere, the system has not been stopped up since the use of this soap was initiated. It is also reported that no cases of dermatitis, which could be connected with the use of the system, have been encountered during this period.

In addition to these 11 systems, the plant is served by two central systems from the propane station, one containing pure propane, and the other with entrained air (which makes the propane interchangeable with natural gas). Propane station consists of two 30,000-gal tanks, with provisions for receiving from either cars or trucks.

Other systems contributing to the total of many miles of pipe in the building include three water systems —well water, zeolite-softened water, and demineralized water. Hot water is furnished, not by a central system, but by local heat exchangers, where the building steam is used to heat the necessary amount of the right type of water to the desired temperature.

Steam system consists of a complete loop of the plant. Duplicate 10-in. lines run from the header in the power plant across the bridge shown in Fig. 2, and circle the plant from their point of entrance. This enables any part of the line to be isolated, even during the period of greatest heating load. Heating units in the manufacturing section are located in the truss area.

Condensate is collected, of course, in a loop similar to the steam loop in configuration, and parallel to it.

Natural gas, hydrogen, nitrogen, and a wet-type sprinkler system are the other central systems. A less expansive but equally interesting system in the plastic molding section consists of high and low-pressure hydraulic lines serving the various presses. Pressures are 3000 psig and 250 psig, respectively.

Electrical Aspects

Plant receives its electric power from the local utility at 34,500 volts, through two independent feeders. Distribution is at 2400/4160 three-phase grounded wye. Load centers are located in the truss area. Single-conductor cables are used for the majority of the distribution, which is underground, with three-conductor armored cable being used for the risers to the load centers.

There are six emergency generators in the Automatic Electric plant. One of these is a steam-turbine-driven, 150-kw synchro-start generator, which is capable of handling essentials in the power plant in the event of an outrage of the power company sources. The other five are strategically located in the truss areas of the main plant, and are powered interchangeably by either propane (air-entrained) or natural gas. There are four 25-kw units, and one 37.5-kw.

Air conditioning is furnished for the offices only, with the well-insulated manufacturing areas merely ventilated. There are two 600-ton compressors in the building basement, and a four-stage cooling tower on the roof. Treatment of the cooling water is completely automatic, with chromate controlled by sulfuric acid, to give the desired pH level. This level is recorded constantly.

Provision has been made for flooding the roof when the air-conditioning load becomes high, and a chlorinator has been provided to control the growth of algae in the roof water.

Communications

Communication systems are multiple. In addition to some 500 phones rented from the local system for incoming and outgoing calls, there is an internal system with 2200 outlets (manufactured, needless to say, by the Automatic Electric Co). For the distribution and collection of mail, and for intraplant messages and the handling of blueprints from a central library, there is a system of tubes and carriers totalling over 30,000 ft.

Feature of this system, which is vacuum-operated, is the automatic addressing system. From any of 36 outlets, the 4-in. by 7-in. by 14-in. oval messengers may be dispatched to any other station by simply dialing two numbers on the control system. There is no handling by messengers at the central station, this being done pneumatically and electrically in accordance with the dialed instructions. Not over 90 sec is required to reach any station from any other.

There is also a loud-speaker system, through which announcements may be made to any department, or throughout the building. Music is played through this system on various occasions.

Both the plant and all of its utilities have been designed for expansion as needed. Although this is already probably the largest light-manufacturing building in the country, some expansion might be required sooner than expected. THE END

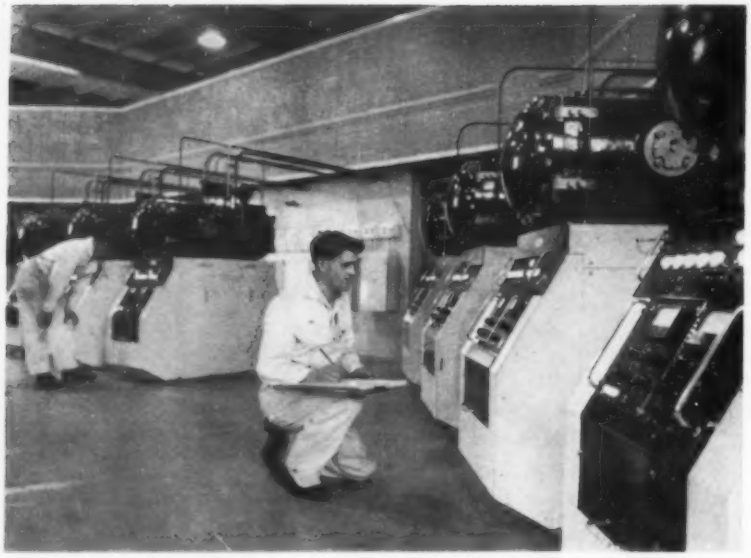


Fig. 1. Training program lasts from 4 to 16 months, concludes with periods of actually doing a job under supervision. This view was taken inside the Sniffer Control Room at Calder Hall

By K. J. FROST* and
E. S. RIPPON†

How Atomic

FROM A TRAINING point of view it is obvious that the United Kingdom Atomic Energy Authority, being the only organization with design and operating experience, is committed to train both designers and operators for the Consortia and Electrical Generating Boards in Britain as well as its own staff

Basic plan of operator training has been to give experience on similar plant whenever possible. For the Calder staff who were to operate the reactors there was the training ground of the Harwell and Windscale piles. These people were therefore given as long a period as possible on the piles or recruited directly from the Windscale staff. This, combined with an extensive period of familiarization with the plant before start-up, carrying out commissioning tests, operating the charge discharge gear, etc, gave a staff trained as far as possible at that stage. All operations were initially carried out under supervision of a senior physicist or engineer until the more junior operators were competent to do this themselves.

In 1956 a survey was made by the U.K.A.E.A. of the number of people who required some form of training within the Consortia and Generating Boards. The requirements fell into three main categories: design, construction and operation. Numbers in each category were fairly large, but the operational group proved to be the largest. Although most of the operators could be expected to have had conventional power station experience, none of them would know initially anything about reactor operation. It became obvious therefore that some form of basic operational training was desirable, which could then be augmented by suitable training on the plant where necessary.

In the light of this information, the Authority decided to set up the Calder Operation School to give the basic training. The demand is made up in the following manner.

If the procedure which is normal for conventional power stations is followed, then when one of the Consortia builds a nuclear power station it would be committed to proving the station over an initial period of operation. This means that a special operating team is necessary which will take control, but work in close liaison with the Generating Board's station-operating staff. The team will comprise physicists for the technical side of loading to criticality, determining reactor characteristics, etc, and engineers for the engineering operation of the components. Some 12 people are expected in each team. Staff of the Generating Board, on the other hand, will comprise senior managers, technical operations engineers and physicists and the shift supervisors, this latter group being the largest.

Next stage was to devise a comprehensive training program which would embrace the training of staff of the Atomic Energy Authority, the Electricity Authorities and the Consortia.

Outcome of this was a three-stage program: schoolwork; study of work being done; carrying out of work under supervision.

Schoolwork

Under this heading, one of a number of courses are to be used, the choice depending on the duties for which the man is being trained. The work of the Harwell Reactor Course is well known, and will not be described here. This course is appropriate for the man who is training to be a reactor physicist. The course is actually made up of two parts, and run by a number of Technical Schools.

Some organizations may prefer to send their senior operational staff to the latter instead of to the whole course. For those who need a more practical approach, a six-weeks course has been organized by two local Colleges (at Whitehaven and Workington) to be run in close collaboration with the Calder and Windscale Works. Factory facilities — such as experimental equipment and instruments — are integrated with the course, which is run primarily to fit in with the flow of trainees. This course is particularly suitable for engineers who will be in charge of shift operation. Finally, there is the Calder Operation School, which will now be described in some detail.

At Calder Operational School

First course at the Calder Operation School started on January 28, 1957. Although satisfactory, it showed that some information could be better presented in a different way, so that the program and system to be described concerns the five subsequent courses held to date.

Each course lasts for six weeks and has as its objective the giving of as much basic operating knowledge of the Calder reactors as possible. From the outset it is important that each student fully appreciates the fact that the station is primarily designed to produce plutonium and does not operate with a fluctuating electrical demand. The first lecture therefore gives the reasons why Calder was designed with an off-load system of charge and discharge and why the steam conditions are poorer than those in the original Harwell design study.

Following this lecture come others

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BACKGROUND OF ATOMIC ENERGY IN GREAT BRITAIN

When the British Government decided to set up an organization to produce nuclear weapons it was natural that this should be placed under the Minister of Supply whose department is responsible for weapons production. Under this organization the air-cooled graphite-moderated research piles BEPO and GLEEP were built for the Research Group, and later the air-cooled graphite-moderated plutonium producing reactors at Windscale, for the Industrial Group.

In 1955 the Government decided upon a nuclear power program of 2000 mw electrical installed capacity by 1965, and in 1956 this was stepped up to 6000 mw. The stations constructed to produce this power were to be built for and operated by the nationalized Electricity Generating Boards. These Boards, with assistance from the Atomic Energy Authority, specified their requirements and asked for tenders (proposals) from certain British industrial groups, or Consortia, as they are generally called. There are now five Consortia, each of which is headed by a heavy electrical producing firm, and their organization is geared to design and build complete nuclear power stations.

In 1954 the atomic energy organization was taken out of the Ministry of Supply and made a separate organization known as the United Kingdom Atomic Energy Authority, thereby giving it greater flexibility.

Summarizing, there are three main groups interested in nuclear power in Great Britain:

1. U.K.A.E.A., which acts as consultant to the other two groups and whose function in this sphere is to design, build and prove, by operation, reactors considered suitable for nuclear power development. Calder Hall and the Dounreay fast breeder reactor are examples of this.
2. Industrial Consortia, which have grouped together to design and build nuclear power stations.
3. Electrical Generating Boards, which will operate these stations.

Power Operators Are Trained in Britain

dealing with the principles of operation and control and instrumentation. Those form an initial basis on which the detail of the remainder of the course is built.

Remainder of the course can be split into four main sections: 1. health physics and safety; 2. more detail and operating experience of plant items, with visits to operating plant and construction works where possible; 3. reactor operating, covering all facets from commissioning tests to normal operation; 4. heat exchanger and turbine hall operation.

In 1 comes charge and discharge of the reactor, and whenever possible the student is allowed to see this. Since it is the operating policy of the Authority to keep to a minimum the number of areas which may become relatively contaminated, it is important to deal with the health physics aspects of the work before the student witnesses the charge/discharge.

Figure 2 shows the charge/discharge procedure. The cartridge preparation room must be free from contamination and so the only areas where contamination of any degree is permitted are on the top of the reactor, down the discharge well and at the bottom of this well. Change rooms are therefore set up at the top of the reactor, and at the bottom of the discharge well. The procedures adopted, the types of instrument used, the checks that are made during this period, and methods of decontamination, where necessary, are dealt with.

Further lectures are given on the normal survey work around the plant, personnel dosimetry and special precautions taken during maintenance work.

2. *Plant items.* In order to understand thoroughly the operation of any plant it is necessary to know its design and the philosophy behind it. Special lectures are therefore given on reactor instrumentation, pressure vessel and heat exchangers, reactor core and charge/discharge machinery, to mention the most important subjects. In every case the lecture is accompanied by a visit to the plant to see the equipment at first hand.

When talking about the pressure vessel, heat exchangers and core, questions are inevitably asked concerning their construction. In all cases there is a film available, taken during the construction phase, which shows this. The construction of the core is further illustrated by a small stack of graphite bricks and tiles — of the type used in the reactors — which is kept in the School.

Talks on the charge/discharge gear do not give the student an adequate understanding of their functions and so, use is made of the test bed which was constructed to check the operation of all equipment and machinery before an actual charge/discharge. By this means two of the more difficult tube preparations are demonstrated.

3. *Reactor operation.* After the early talk on the principles of operation the student is taken through the following stages:

Mechanical commissioning tests. Some of the tests carried out at Calder will be repeated in a similar manner on other stations and since the plant operators normally have to accept or reject equipment on the results of such tests, an understanding of them is important.

Start-up nuclear experiments. These cover many aspects, as for example, loading to criticality, determination

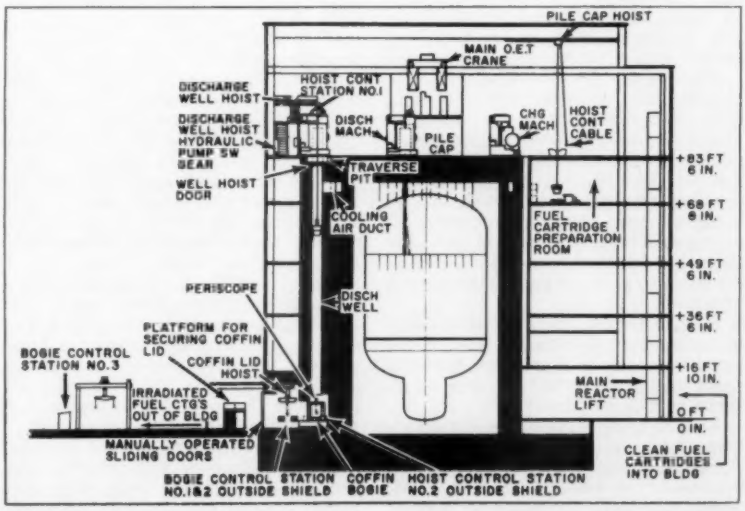

Fig. 2. This is elevation of Calder reactor building showing handling details

Fig. 3. Reactor simulator is an important piece of teaching equipment at Calder

of migration lengths, extrapolation lengths, temperature coefficients, etc, control rod calibrations and the sensitivity of the burst cartridge detection equipment.

Start-up, shut-down, normal and abnormal operation. This talk is an extension of the early one and deals with the subject very fully. Reasons for various trip settings are given together with the effects on the reactor of various operating conditions on the heat exchangers. At the same time, the procedures for taking a complete gas circuit out of operation are dealt with, as are the actions to be taken under various fault conditions.

The talk mentioned above is arranged towards the end of the course so that the students have a chance to see an actual shut-down and start-up, if one occurs, and also to operate the reactor simulator.

The reactor simulator is a very important piece of equipment to the School since it is designed to act in a manner similar to that of the reactor. Figure 3 shows the layout, which consists of a control desk, instruments, operating handles, etc, which are just as found on the reactor. To the left and right are two cabinets, one containing fault and warning switches, whereas the other has fault and warning alarm indications, together with a number of trip relays.

The reactor kinetics and heat exchanger side are simulated electronically with time delays, e.g. between uranium and graphite temperatures, similar to these experienced on the reactor. The kinetics are accurately simulated except for the exclusion of Xenom and long-term reactivity changes. The heat removal side, on the other hand, is a simplified circuit designed to give the general responses expected.

Each student spends half a day operating the simulator, under instruction. He is normally able to carry out a full start-up and shut-down during this time.

During normal operation three factors must be checked periodically. First, the heat production of the reactor must be known reasonably accurately from the point of view of burn-up of fuel. The ion chamber instruments recording the power level are checked by determining the heat output from both the gas coolant circuit and the steam circuit. Each student carried out such a check to give him an understanding of what is involved, and the accuracy obtainable.

Secondly, the flux distribution of the reactor is important from the fuel burn-up point of view. It is on the basis of fuel burn-up that the charge/discharge program is decided. After carrying out a flux plot, which involves drawing a number of graphs and making many calculations, a talk is given on the interpretation of the results and the many other factors which can be read into these as, for instance, the relationship of flux distribution to control rod distribution, its relationship to the temperature of fuel elements and other items.

Thirdly, long-term reactivity changes are of very great importance because they affect the degree of control exercised by the control rods, the flux distribution and other things. This talk is normally extended to cover the type of charge/discharge program to be expected on an Electrical Generating Board reactor in order to obtain bulk irradiations of 3000 MWD/Te.

4. *Heat exchanger and turbine hall operation.* Turbine hall operation is more or less conventional and so this section of the syllabus consists of a talk outlining the operation, followed by a detailed tour of the plant. Heat exchanger operation, on the other hand, is important, and so a separate talk is given about this, particularly emphasizing the effects of changes in reactor condition on their heat removal characteristics.

Apart from the main stream of lectures given above, there are a few special ones concerning particular aspects of the plant. One on heat transfer gives the reason for and experimental work which went into the design of the extended fin surface of the fuel elements. Then a metallurgist outlines the problems of fuel element manufacture and some of the problems associated with fuel elements under irradiation. Finally, advantage is taken of the fact that Windscale Works is so near, for students to visit the fuel element cooling ponds and decanning bay, and also have a visit around the primary separation plant.

A few words on the system of presentation of the information may be of interest. Since it is not possible to study most of the subjects dealt with from a standard text book, it is important that the student understands the reasoning behind each lecture. Furthermore, there may be more than one method of carrying out a particular operation and the student needs to know why an alternative method is not used.

To cope with this, the sessions are of three hours, each starting with a talk during which a few questions are asked and followed either by a general discussion, a continuation of the talk-question arrangement, or the introduction of an exercise or visit. It is obvious that the best people to give the talks are the operating staff themselves and so the School staff give the more general information, leaving the Calder operating staff to give details.

For this method to be a success the student-student and student-lecturer barrier must be pulled down as quickly as possible. A buffet supper is therefore held on the first evening so that students and lecturers can meet each other in an informal atmosphere. The system has certainly achieved its objectives so far.

Study of Work Being Done

In addition to the techniques of nuclear good housekeeping, the trainee will need to know the protective features of the design, the codes of practice (limits) which apply, and do some laboratory experimental work.

After this initial training the course depends on the job for which the man is being trained. Staff who will be in charge of actual operation spend some months studying the details of the control room and the ancillary plant, and are passed out as qualified to control the reactor. This will be followed by a period with the shift manager, and another period with the reactor physics section. Maintenance engineers spend periods with their opposite numbers — mechanical, electrical or instrument maintenance engineers — and in the case of the latter, a special course of lectures is available, if the engineer's previous experience in this field is limited.

Work Under Supervision

Finally, there are periods of actually doing a job under supervision. Posts have been created at the Calder Works to allow operational staff to take charge of a shift, and later to hold a more senior managerial post; and in the same way, maintenance engineers and physicists will carry out individual assignments.

Acknowledgement is made to the Managing Director of the Industrial Group of the United Kingdom Atomic Energy Authority for permission to publish this article. THE END

Power Engineers' Valve Manual . . . .

This fifth article, in a series on valves commonly used in the power field, deals with Gate valves. Preceding articles covered Plug, Check, Blow-Off and Globe valves. When completed, the series will be reprinted as a Valve Manual for power engineers in all fields and industries

GATE VALVES

By JOSEPH A. CEROW, Jr

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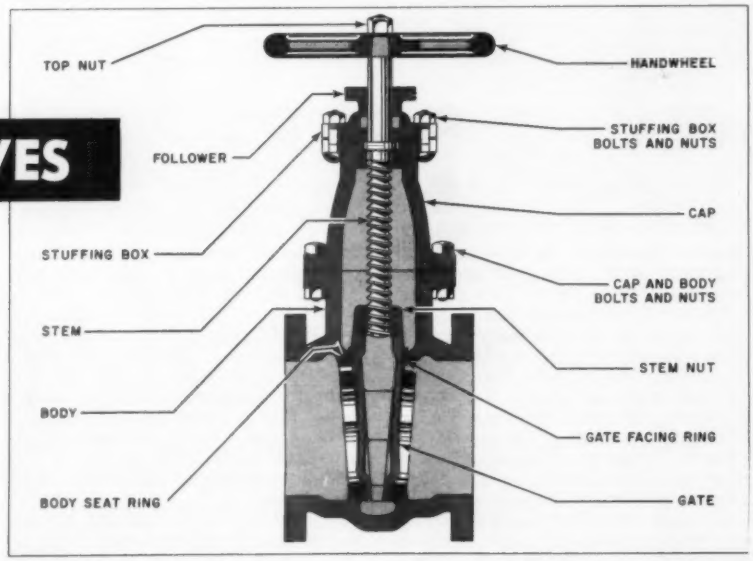
Before joining Chapman in 1938, he was connected with the Brooklyn Edison Co and the Consolidated Edison Co of New York in engineering capacities. His appointment as Sales Manager of the Steam Utilities Division at Chapman came in 1948, and he was appointed Vice-President in Charge of Engineering in 1954.

Mr. Cerow is a member of the American Institute of Electrical Engineers, the Engineers' Club of New York, Massachusetts Society of Professional Engineers and American Society of Mechanical Engineers.



IN THE LAST hundred years, valves have settled down into basic types such as gate valves, globe valves, check valves and others. This article will deal principally with the basic type called gate valves.

Gate valves are primarily for open and closed service, and are not particularly adapted for intermediate flow regulation or throttling service. Due to their low head loss, which is only slightly greater than the equivalent length of pipe, they are particularly adapted for those services for isolation of equipment, where for long periods of time they will remain in the open or closed position, and offer little or no obstruction to the flow of fluid in the pipe line.

Characteristics of this Type

Gate valves cover a wide range of sizes in common American practice — from ⅜ to 108 in., although in later years the 84 to 108 in. sizes have been supplemented by the butterfly valves, usually due to the space limitations under which they are installed.

Gate valves have been used successfully in temperature ranges of minus 300 F to 1800 F, and at pressures of from a few ounces of gas to thousands of pounds per square inch. Naturally the wide range of pressures and temperatures under which these valves are utilized necessitates a very wide range of materials of construction. Materials that are suitable at minus 300 F might not be suitable at 1800 F. At the present time gate valves are being manufactured in brass and bronze, several grades of gray iron, the newer ductile iron and the whole gamut of steel types, together with numerous special alloys for corrosion services.

The "trim" materials for the noncorrosive seats are being made from bronzes, stainless steels, Monel and hard facing alloys. Valve stems cover a wide range of materials based on the temperature and pressure at which the valve is to be used. In addition, at elevated temperatures, ingenious means must be provided to keep the valve spindle stiff in order to resist column action occasioned by the operation of the valve.

Originally, in this country, valves were made in the smaller sizes with screwed connections and in the larger sizes with flanged connections. With the development of welding techniques in the early 1930's, valves were made with welding ends to be welded to the pipe in which the flow is regulated. Later, other types were developed, namely, pressure seal joint, "O" ring joint, and so on.

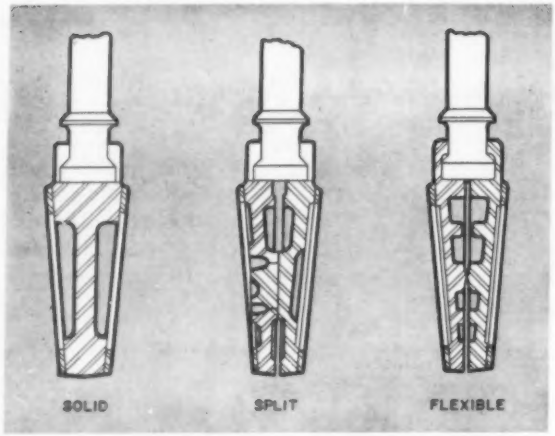


Fig. 3. Three types of gates; solid for general applications; split for high-pressure one side; flexible for both sides

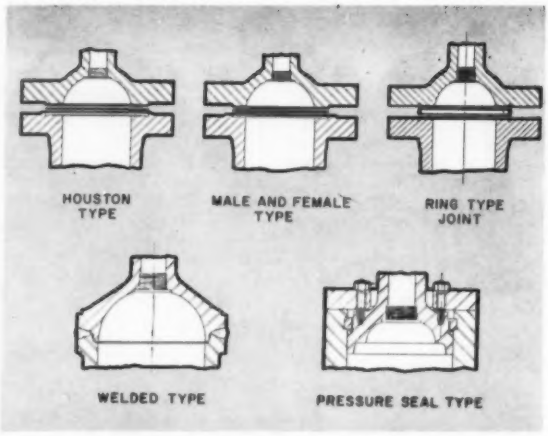


Fig. 4. Illustrations of common body and bonnet joints used in gate valve construction. All are standard schemes today

In their simplest construction, gate valves have a valve stem, or spindle, which projects from the waterway to the outside atmosphere, for controlling the gate. This necessitates some method of retaining the fluid in the pipe line. Rope packing with a gland was the principal means of resisting this leakage. The gland is still the most widely used method. However, the materials used for the packing have been changed and improved. Today gate valves are made in some instances and for special applications with trick glands such as "O" rings or bellows seals; and, for atomic jobs, where any leakage would be disastrous, with canned or hermetically-sealed construction which eliminates the need for a gland.

There are a great many variations of gate valve designs. The principal one that comes to mind is the bonnet joint where two halves of the gate valve bodies are fastened together.

In the small bronze valves, common practice was to use screwed joints or union bonnet-type joints. However, as the valves became larger, or the pressures or temperatures were increased, other means had to be developed to retain the pressure. On the larger valves the joints were of the flanged type with many variations of gasket types and material. These proved satisfactory for a long period of time, but as pressures and temperatures were increased in central stations and oil refineries in the 20's, it became necessary to find a type of joint that would remain tight for longer periods.

The "Sargol" type (or combination joint), which is a flange joint with a seal weld, was at first thought to be the answer. With the development of better bolting materials and gasket materials, the early difficulties with flange joints were eliminated, by the development of the "Houston," or ring joint. Again the central stations did not remain idle but increased the pressures and temperatures up beyond the limit of bolting materials.

As a result, designers had to make a design to contain these elevated temperatures and pressures. In 1936 the first all-welded construction with a welded bonnet joint was brought out by The Chapman Valve Manufacturing Company. By 1946, the pressure-seal type joint, developed for feed water heaters and heat-exchangers in Europe, was applied to gate valve bonnets. High pressure valves for central stations are largely of the welded, or pressure-seal, bonnet type construction.

The advent of the atomic energy program, with its necessary extreme tightness of the bonnet joint and ready accessibility for taking apart, has forced the designer to reach back into the 1920's to the "Sargal-Sarlun" joint, with the added advantages of better materials, better welding techniques and better control of joint configuration.

Gate Valve History

In the early days of the gate valve, the gate was parallel-sided, and was pushed into place in the main pipe line, to shut off the flow by relying on the pressure on the upstream side. The pressure of the fluid on the upstream side was relied on to create the necessary force to seal off the valve. Elaborate methods were developed in subsequent years so that the gate was pushed tight against both faces, by mechanical means, making the action of the valve independent of

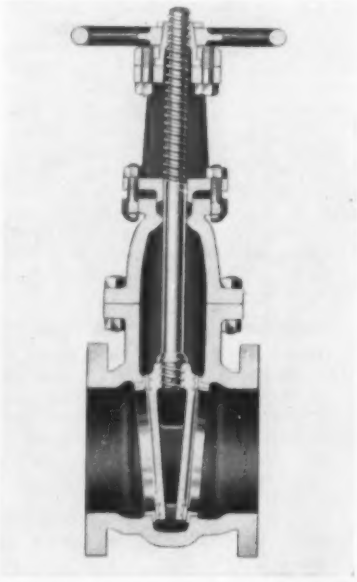


Fig. 1. Rising-stem gate valve. Used where position of gate must be indicated

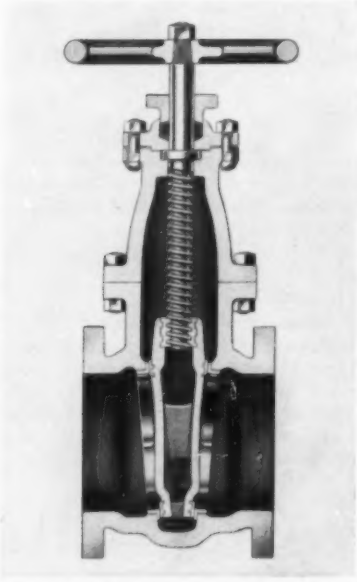


Fig. 2. Same valve as in Fig. 1, except non-rising stem; for low head-room

the pressure in the pipe line. This type of construction had the disadvantage of a large number of delicate parts which were subject to attack by the fluid in the pipe line.

In the 1860's, a man named Chapman, while chopping wood one day, looked at the shape of the axe head and invented the solid wedge type gate valve as we know it today. Later, as the tendency to combine the advantages of both the solid wedge and double disk gate valve was tried, a design was evolved known as the split wedge. This type of construction has the advantage, although more expensive than the solid wedge, of being able to adapt itself to small amounts of distortion occasioned by pipe line strain. It also offers the peculiar advantage for those special installations where it is desired to seal the space between the seats with steam or inert gases.

Lately, a new variation has come on the market, the so-called "flexible wedge," wherein the wedge is in one piece but cut out between the two seats in such a way as to provide a small degree of flexibility. It offers the added advantage of relieving the valve spindle from excess stress when it is necessary to close the gate valve when subjected to extremely high temperature. In this connection it might be interesting to note that the atomic energy field again has dipped back into the 1920's for a valve construction with parallel seats, and relying on the pressure in the pipe line to keep the valve tight. This has been possible because, although the pressures encountered with pressurized water reactors are high, the temperature is less than 600 F.

Due to the type of service in which gate valves are used, they often require little or no replacement of parts. In extreme service it may be necessary to replace seat rings, gate, and valve spindle. The latter usually has to be replaced because of abuse.

Fig. 7. Shipment of large size gate valves which have been completed and tested, and are ready to be delivered for installation. Note operators on top of valves

Valve Standards

Today's modern gate valves are made from very carefully controlled materials. The materials are usually specified to American Society of Testing Materials' specifications. Pressure-temperature ratings have been standardized by the American Standards Association (B16 standards). Dimensions have been standardized so that usually the valves from one manufacturer are interchangeable with another. In addition, where the standards associations have not seen fit to publish a standard, the Manufacturers Standardization Society of the Valve and Fittings Industry has published what they call Special Practices. Other standards are in the process of being developed for radiographic examination of valve parts for exacting services of nuclear and supercritical installations. Other special testing specifications are being prepared which undoubtedly will be adopted as standards by American Society of Mechanical Engineers.

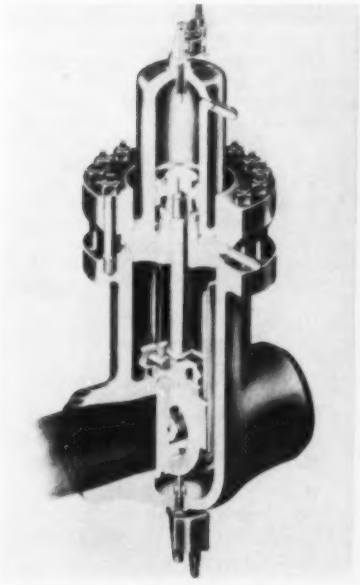


Fig. 5. "Canned-type" valve for atomic plants. Must be completely leak-proof

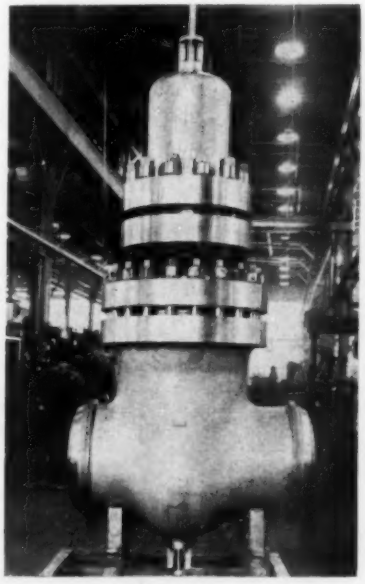


Fig. 6. Photo of actual "canned" atomic valve, illustrated by drawing in Fig. 5

Operation of Gate Valves

When we think of the method of operating gate valves we immediately think of a handwheel, as it is only necessary to turn the handwheel clockwise to close it, or counterclockwise to open it. However, the sizes of gate valves have been increasing, and pressures and temperatures have been increasing; and, as a result they far outstrip the strength of one man operating on the rim of the handwheel. A 10-in boiler feed valve in a modern power plant quite often has a load on the valve stem equal to 25 tons or more. Obviously, without mechanical assistance, an operator is not going to be able to turn the handwheel to operate the valve. In order to provide mechanical assistance for operating these valves it is necessary to calculate the operating effort required, which is usually assumed to be com-

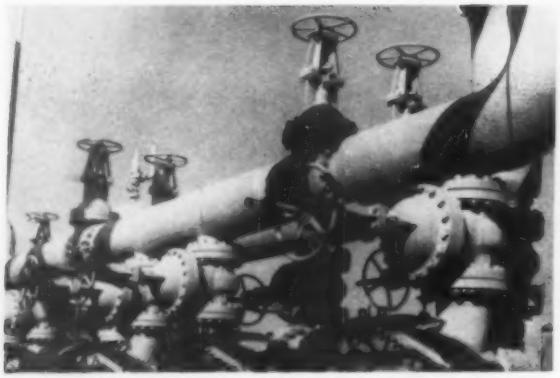


Fig. 8. Typical installation of gate valves in outdoor piping system. Rising-stem gives visual indication of gate position

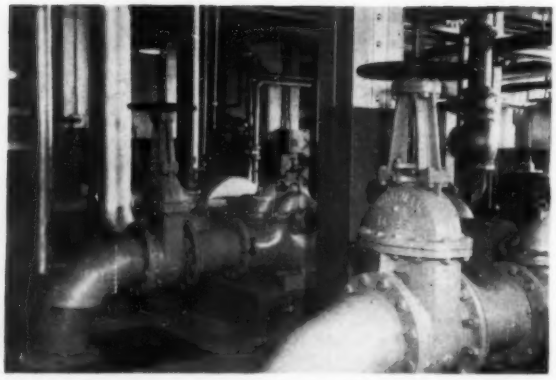


Fig. 9. Shown are two 14-in. steel gate valves, installed inside plant. Used for infrequent operation on pump service

posed of three principal parts.

1. Pinch on the wedge, either occasioned by the thrust required to seat it, or by thermal contraction and subsequent cooling, after a high temperature valve is closed.

2. Sliding friction of the sliding gate over the seat, which is a function of the differential pressure across the valve and the coefficient of sliding friction of the seating faces.

3. Piston effect of the valve stem occasioned by the pressure inside the valve being higher than the atmospheric pressure. To this should be added stuffing box friction, occasioned by sliding the spindle through the tight packing of the stuffing box.

The usual method of calculating the thrust on the valve stem is to multiply the area of the gate (in contact with the seat ring) by the difference between the upstream and downstream pressure in pounds per square inch. In the case of *globe* valves, where it is necessary that the disk be wedged into the seat, the effort would be just as great. In the cast of *gate* valves this would be multiplied by the coefficient of friction of dry metal seats sliding one over the other, depending on the seating material. This value varies between 0.2 and 0.3. For example, when 100 sq in. of gate is subjected to 100,000 lb of pressure, the load on the gate would be 100,000 lb; and if the coefficient of friction of the seats was assumed to be 0.2, the load necessary on the valve stem to cause the valve to slide would be 0.2 of the 100,000 lb, or 20,000 lb, or 10 tons. In the case of globe valves the load would be the full 100,000 lb.

Most power-operated or hand-operated gate valves employ a screwed valve spindle to control the movement of the gate. Using the screw jack formula, with an assumed valve spindle 1⅞ in. diam, with ⅓ in. pitch, ⅓ in. lead and 0.3 coefficient of friction, and ball- or roller-bearings under the yoke nut, the above example would result in a torque of 530 ft-lb. If the handwheel was assumed to be 2 ft in diam with a 1-ft radius, a man would have to exert 530 lb at the 1-ft radius, which is beyond his strength. A man is assumed to be able to exert 40 to 100 lb on the rim of the handwheel. If the handwheel diameter was increased to bring the effort lower, the radius of the handwheel would have to be 5 ft 3 in. which is seldom possible.

Motor-Operated Valves

In our example we have eliminated or neglected the effect of the wedge pinch, which is always a difficult matter to figure. Electric motors can overcome this by providing a mechanical hammerblow device to unwedge the valve; and, some hand-operated valves employ mechanical hammer blows. Split, or flexible, wedge valves are not subject to the same stresses, or wedge pinch, as solid wedge valves. We have neglected also the piston effect of the spindle, although this could add another few thousand pounds to the total operating effort. We have also overlooked stuffing box friction on the spindle, which could add a ton or more to the operating effort.

In considering this problem, the first thing that comes to mind is the use of gearing as a means of reducing the effort. There are a great many gear heads on the market today, most of which employ worm-gearing, due to the compactness of the gear ratio. Worm-gears are available with a gear ratio as high as 40 to 1. However, while we have reduced the effort at the rim of the handwheel, we have sacrificed speed. In the example mentioned, the valve would have operated in thirty turns of the handwheel. If we put in an 8 to 1 gear ratio, we have increased the number of turns by eight, or from 30 to 240 revolutions.

If the valve is to be operated once a year, and time is not a problem, a man or a relay of men could operate the valve. If the valve is to be opened and closed every day (or every few hours as in process work), we would be faced with a labor problem, and some other means would have to be employed. Electric motors are often used to drive the gearing for operating valves. This presents the problem of how to stop the motor at extremes of travel. There are two methods of doing this.

1. A positioning limit switch which, after a definite number of turns of operation, trips to deenergize the motor.

2. When the valve seats, the load on the motor builds up, and a sensitive device trips the motor from the line.

Actually, both methods have their disadvantages. As this is not an article on electrical valve operation, we do not wish to become involved in the relative merits of the two methods.

Substitution of pneumatic motors, for electric motors, or valve operators, is one alternative for taking the drudgery out of valve operation. Piston operators are also employed extensively on low-pressure valves, in waterworks systems.

The designer of a piping system would do well to take the time to familiarize himself with what is required to open or close the valves he has specified, taking care to specify which valves need gears, and which need electric motors.

In addition to the selection of the proper valve operator, the designer should pay careful attention to the physical placement of valves to avoid conflicts. THE END

Valve Manual Reprints

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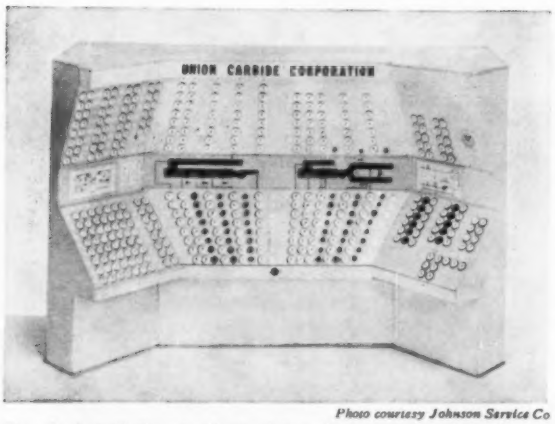


Photo courtesy Johnson Service Co

Fig. 1. Installation typical of trend to embossed and diagrammed central control systems for heating and ventilation

in
. . . HEATING
. . . AIR CONDITIONING
. . . COMBUSTION

Miniature Controls Come of Age

By ARTHUR L. SPAET *

WITH THE many recent changes in heating and air conditioning equipment have come corresponding changes in automatic temperature controls. Increased safety requirements, the demands of a more sophisticated public for better performance and more refined maintenance of room temperatures, and the development of new electronic devices have contributed further to changes in conditioning equipment and control techniques.

Certain trends are apparent in these developments:

1. Miniaturization of equipment such as thermometers, gauges, transmitters.
2. Increased use of remote instrumentation, gauges, and controls.
3. Data control centers. This is a specialized application of item 2 above, and deserves special mention.
4. Redesign of equipment for more pleasing and modern appearance.
5. Noise attenuating and automatic mixing boxes for high velocity systems.
6. Increased application of electronics to control circuits and systems.
7. Factory wired and pre-set control assemblies.

Photos courtesy IBM Co

Fig. 2. Nerve center of a central control system. Note compactness of unit

Automatic Controls Defined

Before discussing the new devices in detail, let's pause for a moment to consider exactly what is meant by automatic temperature controls.

As normally conceived in heating and air conditioning design, automatic temperature controls include two basic types of devices. One is a sensing or pilot device; the other is an actuating or motor device.

Sensing devices may be responsive to air temperature, water temperature, steam pressure, or air velocity, and will consist of such instruments as thermostats, aquastats, pressurestats, static pressure regulators, and similar devices. These are the eyes and ears of any control system. One can also broaden this category to include such refinements in instrumentation as clockwork mechanisms for automatically timed start-stop of motors, radiant thermometers, hygrostats, and outdoor type controllers.

These sensing devices may be all electric operated, all pneumatic, electronic, or combinations of all three.

The actuating and operating devices are essentially motor controlled dampers or valves, corresponding to the fingers and muscles of the system. The motors may be operated by a fluid as with hydraulic cylinders, air diaphragms, or compressed air cylinders. If electrically operated, the operators are either electric motors, frequently with reversible and adjustable speed, or solenoid actuators.

These motor devices are arranged to exert force through a suitable system of mechanical linkage to open or close valves or dampers. Solenoid valves, diaphragm type valves, and automatic damper operators of the piston or electric motor type are familiar and common applications.

By the addition of wiring, piping, auxiliary relays, contactors, and alarms, the above components are combined into an integrated automatic temperature control system.

Miniaturization of Equipment

It is almost a redundancy to note the fact that there is a growing trend toward increased use of automatic devices. A complete new technology

Fig. 3. IBM's dual-coded relay receiver typical of functional miniaturization

*Slocum & Fuller, Consulting Engineers

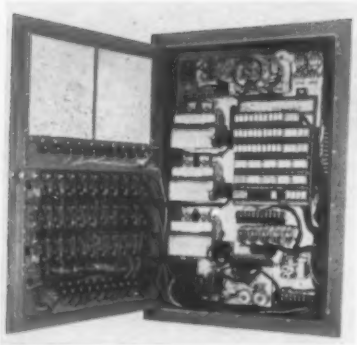


Fig. 4. Visual reason for current trend to the use of factory-wired components

has taken its place on the American industrial scene, under the loose title of automation. Along with this increased acceptance of automatic controls and self-operating devices has come the need for smaller instrument components.

Large gauges and dials were common in early control boards. No self-respecting engineer or contractor who took any pride in his work would install a steam gauge smaller than 10 or 12 in. in diam. As the quantity of gauges and recording instruments increased, however, the size of the control panel increased accordingly, and the need for small gages became obvious. The aircraft industry was one of the first to give impetus to the development of smaller instruments. We now find a similar trend in the field of heating and air conditioning.

Today most of the major suppliers of this type of equipment are making available instruments with smaller gages and dials. Many catalogues refer to this type of equipment as miniature indicators. In the normal sequence of events, it is probable that the word miniature will disappear and the small type of gages, with dials approximately 3 in. in diameter, become accepted as standard equipment.

Remote Motor Controls

While there is still some disagreement among design and operating engineers as to the merits of remote vs local starting of air conditioning motors, there is no doubt that in a large plant or office building, centralized starting and stopping of small and medium sized motors for the air conditioning equipment has distinct advantages. This applies to motors up to approximately 50 to 75 hp. Larger motors are preferably started locally, with the motor in full sight of the operator.

One of the factors that has always caused the design engineer to pause and reflect before specifying remote starting of motors is the added cost of the electric wiring and conduit from the central control panel to every remote machine room in the building.

Equipment developed by IBM permits remote starting and stopping of motors without interconnecting control wiring. This system is based on an extension of the principle that several types of electric signals can be transmitted simultaneously through one set of wires This was first applied by IBM to their clock systems, by means of which clocks could be controlled and corrected throughout a building from a central transmitter, without the necessity for control wiring. Corrective impulses are transmitted directly through the 110-v building power wiring. Each clock receives the impulses through a small radio-type receiver.

Similarly, the IBM motor control equipment consists in effect of radio transmitters and individually tuned radio receivers at each motor starter. The medium which carries the signal from transmitter to receiver is the ordinary power wiring of the building, which will effectively carry a high frequency signal in addition to the normal 60-cycle alternating current. To start or stop any motor, a high frequency signal is transmitted through the power wiring from the central control panel. At some remote point, a crystal controlled receiver will act as a relay to actuate the motor control circuit in response to a signal of a particular frequency. This eliminates the wire and conduit for the usual three-wire control circuit between the motor controller and the motor start-stop station.

Advantages of such equipment are dramatically demonstrated in the installation at Fort Ord, Calif. Hundreds of individual buildings are centrally controlled and scheduled. Signals on a frequency of 5,850 cycles per sec. are superimposed on the existing 60-cycle wiring. If local manual control were attempted, it might take a team of men as many as ten days just to visit each building on the base. The system at Fort Ord can be extended to control any electrical equipment that can be turned on and off with a switch, such as sirens and the air defense warning system, in addition to control of heating equipment. The system was designed jointly by IBM's Time Equipment Division and Fort Ord Engineers.

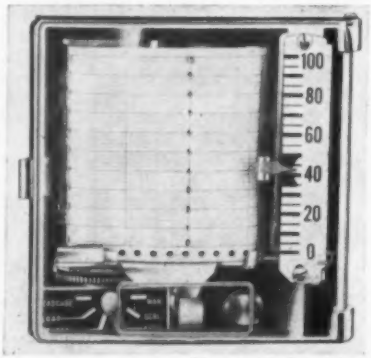


Photo courtesy Bristol Corp

Fig. 5. Six-position recording receiver is one-quarter size of earlier models

Similar equipment performs a host of electric on-off duties at the new Overseas Arrival Building in New York's International Airport. Fans, pumps, unit ventilators, and area and sign lighting are controlled without special control wiring. It is of interest to note that not one but six control signal frequencies are used; the signals are transmitted both on the primary as well as on the secondary 60-cycle power distribution systems. Skidmore, Owings & Merrill were the architects, and the New York Port Authority engineering staff supervised the electrical design.

Remote Reading Gages

Previously, requirements for remote temperature readings were met by use of the thermocouple and electric wiring between a sensing device, an amplifier, and an indicating or reading device. By adding suitable wiring and control devices, certain electric operated remote reading temperature devices permit the additional refinement of remote reset or remote adjustment of temperatures.

A recent application of an old principle permits transmission of room or duct temperatures to remote points by means of pneumatic instruments. This eliminates electric wiring, conduit and electric amplifiers, and substitutes the less expensive pneumatic control tubing and pneumatic devices. This equipment includes a pneumatic sensing device such as an insertion thermostat.

About the Author

After three semesters of civil engineering at Georgia Tech, Mr. Spaet received his degree of BME from City College of New York. He spent five years in the infantry and signal corps in World War II and joined the consulting firm of Slocum & Fuller in 1949. Rising to the position of Chief Engineer in 1952, he became a partner in that firm in 1956. He is active in various technical and professional societies and is a member of Pi Tau Sigma.

Variations in temperature are transmitted as variations in air pressure, and the remote reading device is a Bourdon type pressure gage, calibrated to read directly in temperature.

Another interesting change in the technique of running pneumatic control lines is the use of plastic tubing. Up to this time, pneumatic control tubing was of steel pipe or copper tubing, installed at a relatively slow and tedious pace, one tube or pipe at a time. Today, availability of plasticized or semi-rigid polyvinyl chloride or polyethylene tubing can make the piping instrumentation job go much faster. Tubing is installed in multiple, with many tubes grouped together inside a single protective jacket. Identification is simplified by having the tubes in brilliant and readily identifiable colors. This is similar in principle to the running of multi-strand cable, which has been commonly used in communications work for a long time. In addition, a flexible armored outer jacket may be used to protect the tubing where protection is necessary.

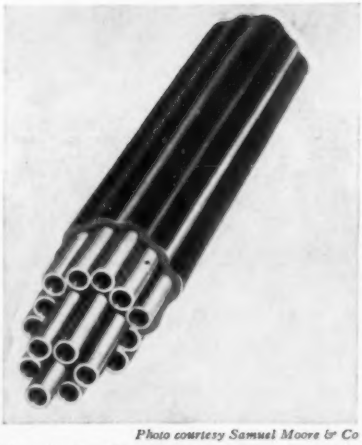


Photo courtesy Samuel Moore & Co

Fig. 6. Bundled plastic tubing is modern method of pneumatic installation

Prewired Control Assemblies

Complete pre-engineered control assemblies have been used in the generation of steam in large industrial and power applications for many years. Manufacturers have made available systems which included all necessary actuating devices, sensing devices, controls, relays, sampling tubes, and a central control and indicating panel.

The trend toward package equipment, and the use of factory-made assemblies and sub-assemblies has now been extended and simplified for application to conventional, relatively small, low pressure steam plants such as are used in ordinary heating, ventilation, and air conditioning work.

Formerly, for small plants, it was necessary to specify a number of individual relays, controllers, disconnects and so forth, each to be individually mounted and wired in the field. It has been our experience that this complex of controls, when left to the not-so-tender mercies of the average field electrician, would frequently be wired incorrectly.

Automatic combustion control circuits and wiring for the small plant have become more complex. Electronic devices are now the rule rather than the exception. In order to give some idea of the complexity of an average system, consider the following operating sequences specified for a recent low pressure oil burner installation designed by our firm:

Operating sequence of burner, on call for heat:

1. Operating control circuit closes. Check all limit controllers.
2. Programming timer starts.
3. Prepurge for 30 seconds.
4. Ignition on. Pilot gas valve open — 10 sec. pilot detection.
5. Main fuel valve opens on low flame.
6. Pilot off. Modulator circuit switches to operating position. Program timer off. Operating controls take over.
7. Normal firing period until operating stat is satisfied, and opens control circuit.
8. Main fuel valve modulates to low fire, and closes.
9. Program timer on. Post-purge for 15 seconds.
10. End of shutdown. Post-purge off. Timer stops.
11. In the event of pilot flame failure or main flame failure, in the event of low water, or in the event of draft failure, the appropriate alarm signal shall light, the alarm shall sound, program relay shall cycle to "post-purge," and then stay "off," and **manual reset shall be required** before burner can be restarted.

From the above operating sequence it should be apparent that the wiring of the control devices and relays requires a fairly high degree of specialized know-how.

It is now possible to purchase for the small low pressure plant a factory assembled, wired and tested package, which includes all the necessary breakers, relays, alarms, safeties, timers, gages, and similar control and recording elements. All the wiring is brought to a terminal strip; the only wiring required in the field is that between the terminal strip and the actuating and operating devices such as the aquastats, or thermostats, or the fuel valve, or the power wiring to the draft fan and the oil burner.

The factory wired and pretested panel has the obvious advantage of being made by suppliers who specialize in this type of work. The panels are assembled and tested by skilled mechanics, who are thoroughly familiar with this specialty. The factory prewired control panel is usually available from the burner manufacturer, or from the boiler manufacturer.

Editor's Note: Mr. Spaet will conclude his excellent treatment of this subject in the next issue of POWER ENGINEERING

Fig. 7. Factory assembled combustion control panel with all relays, alarms, etc is totally enclosed and tamper proof

Photo courtesy International Boiler Works Co

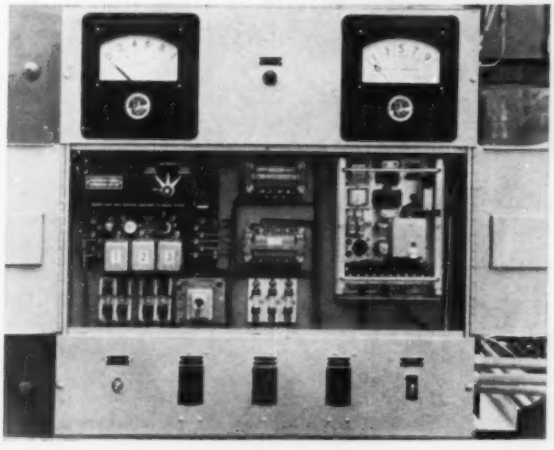
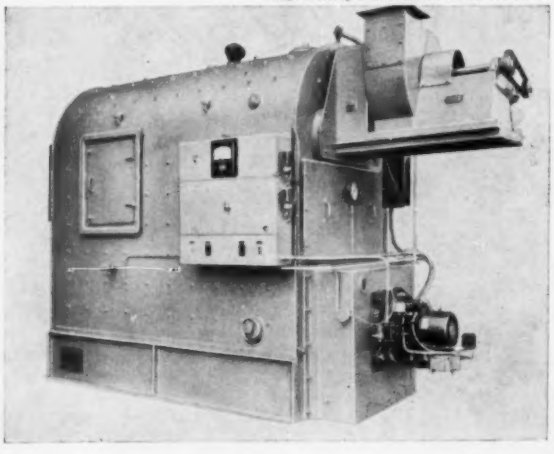
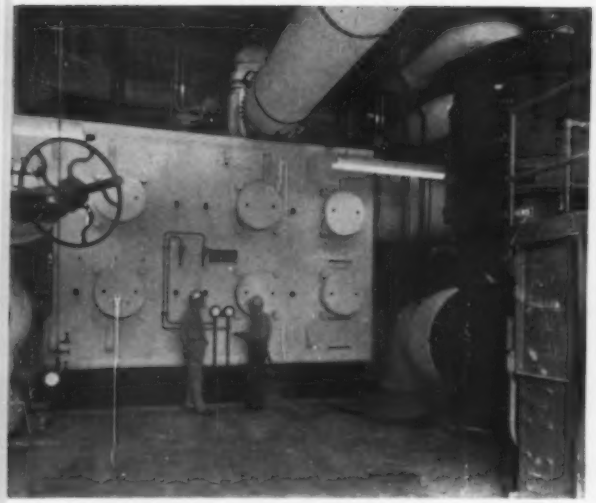


Fig. 8. Package boiler ready for shipment to job-site with control assemblies mounted, adjusted and ready for service

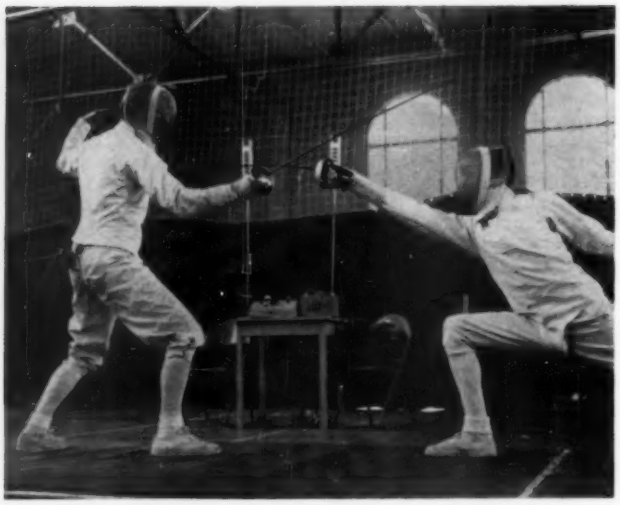
Photo courtesy International Boiler Works Co



Power Engineering's

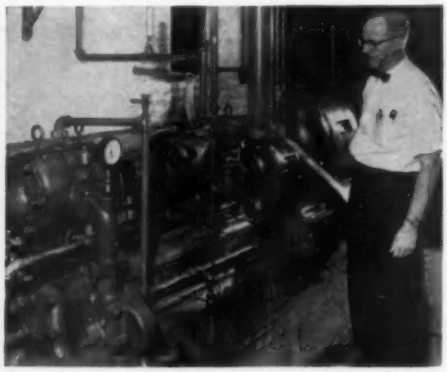


Two 90,000-sq-ft single pass condensers with aluminum tubes make up this unit for the new 325-mw turbine generator which is Unit No. 7 at Commonwealth Edison's station in Waukegan, Ill. Made by Allis-Chalmers, this operating condensing unit is rated the world's largest



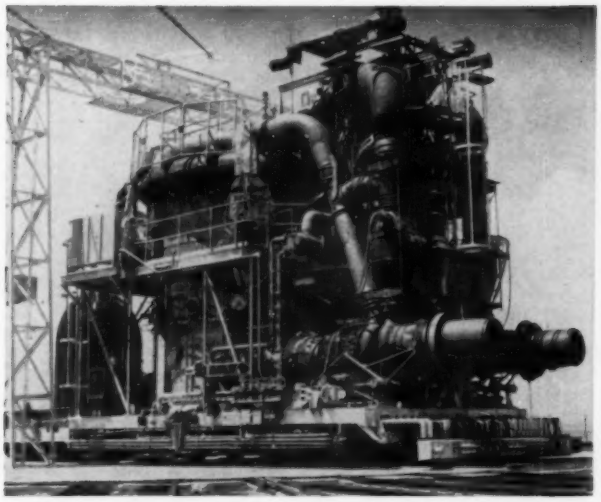
Electrified fencing scores a touch with light and bell signal Each fencer's weapon is wired to form a circuit powered by lightweight, high-capacity Exide aviation battery. Wires to épées are led through fencers' sleeves, then attached to rear of uniforms and led back to spring roller out of fencers' way, and to battery source

This 9-ft-diam rotor is from G-E's new standard line of d-c metal-rolling-mill motors. It's force-ventilated in both 40 C and 50 C ratings, has Class B insulation throughout, improved riser construction, and several other innovations



13 years without downtime is the record of this Fuller rotary air compressor. Installed at Thomas C. Wilson, Inc, in Long Island City, N. Y., it ran 24 hours a day for its first four years, 8 hours a day from then until recent repair

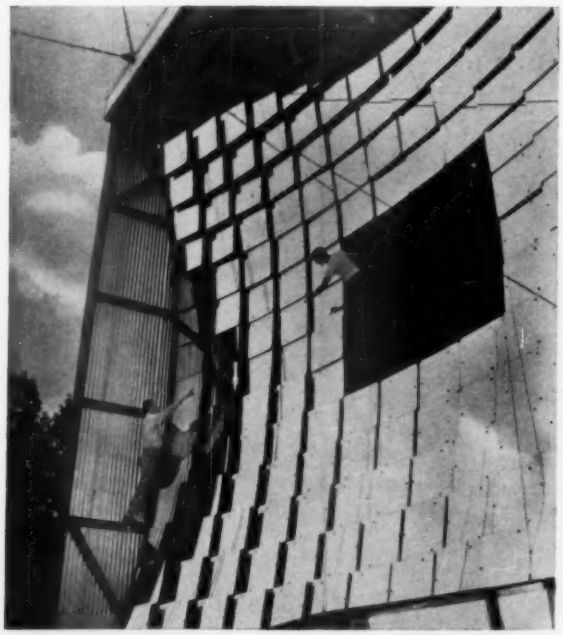
NEWS REEL



Nuclear power for jet engines is the objective of this ground equipment used by the G-E Aircraft Nuclear Propulsion Dept. Large tank contains reactor, which heats compressed air for turning engine turbine rotors. Air then exits from engine exhausts, shown at the extreme right, to give propulsive power

New time-saver is Impactool, designed for use in assembly of pole-top hardware in high tension line construction. Here it's being used to tighten through-bolt in cross-arm. Air supply comes from portable gas engine compressor

First time in use anywhere, these three 250-kva pole-type distribution transformers are being installed here by linemen for Kansas City Power and Light Co. Made by Westinghouse, with areas in mind where bulk power demands are served from pole top, the new unit weighs about 1700 lb



Heart of giant solar furnace of U. S. Army Quartermaster Research and Engineering at Natick, Mass., are these 180 spherical mirrors made by American Optical to an exact curve without grinding and polishing. Sample exposed to furnace should be able to reach 5000 F at image position

Fig. 1. Capt. J. R. Dunford addressing banquet on Navy program for the nation's nuclear powered combat fleet

Fig. 2. Harvey Bumgardner of Detroit Edison gives impressions of Russian power situation gained on recent tour

National Power Conference Draws Record Attendance to Boston

PROBABLY THE MOST SUCCESSFUL meeting of its kind in recent years, the National Power Conference convened at the Statler Hotel in Boston on Sept. 29 and extended through Oct. 2. The conference was under the joint sponsorship of the Power Divisions of ASME and AIEE in coöperation with the Boston sections of both societies. From the moment E. H. Krieg of Stone & Webster mounted the podium to deliver the first paper of the conference, A Look at the Future in Power Station Design, registrants filled the Georgian Room to the point of overflow.

Envisioning generating stations within the next half century with capabilities of 16 million kw that will occupy 600 acre sites and compete with 20-lane highways for these sites; that will require 10–11 million gallons of circulating water per minute and a coal train of eighty 70-ton cars per hr, Krieg set the theme that prevailed throughout the conference.

The conference was divided into seven sessions, three of which were given over to the *rapporteur* style of presentation. This was an innovation for the National Power Conference in which three or four papers were reviewed by an outstanding authority in the particular field of interest and the subject then thrown open for additional discussion by the authors and from the floor. This was particularly effective in establishing concise, well defined areas of discussion and permitted coverage of a much larger number of papers within the allotted time. Andrew W. Kramer, Editor of ATOMICS, served as rapporteur for the session devoted to nuclear energy.

Russian Power System Described

Those attending the luncheon in the Bay State Room on Monday heard James N. Landis, President of ASME, introduce Harvey Bumgardner of Detroit Edison Co, who reported on the recent tour of Russia by a group of top utility executives.

Russia, said Bumgardner, has an estimated population of 200 million and an installed electric generating capability of 48.8 million kw. Of this, eighty per cent is thermal generating capacity and the Russians expect that this will increase to eighty five per cent in the near future. In the past decade their installed capacity has been doubling every five years, but this now appears to be slowing to a six to seven year cycle. The cost of residential electricity is approximately twice that in the U. S.

The largest hydroelectric stations are at Kuybychev with 20 units and at Stalingrad with 22 units, all of 115,000-kw capacity. Current Russian efforts in nuclear energy appear to be concentrated in a 5000-kw boiling water reactor, graphite moderated, outside Moscow.

Largest thermal generating unit presently in operation is 150,000 kw and there are three of these. Under construction is one unit of 250,000-kw capability. There are reported to be approximately fifty units of 100,000 kw in operation. A gas turbine of 55,000 kw-capability is in the design stages.

Bumgardner noted that average Russian residential consumption of electric energy is 750 kw annually as compared with 3200 kw in the U. S.

Fig. 3. W. M. Rohsenow, Professor of Mechanical Engineering, MIT, toastmaster before Power Conference banquet

Fig. 4. Andrew Kramer, editor of ATOMICS, serving as reporter to the conference during nuclear session

Fig. 5. W. E. Hopkins of Stone & Webster and Chairman of Power Division's Executive Committee addresses group

Fig. 6. James N. Landis, Bechtel Corp and President of ASME speaking before luncheon in Statler's Bay State Room

Fig. 7. Ed H. Krieg of Stone & Webster delivers first paper of 1958 Power Conference to record number of registrants

He attributed this difference to the fact there are no electrical household appliances in common use there, nor is there any appreciable manufacture of such in that country.

Dunford Address Is Highlight

The Georgian Room and adjoining parlors was the scene Tuesday evening for the conference banquet, with toastmaster chores in the very able hands of W. M. Rohsenow, Professor of Mechanical Engineering at Massachusetts Institute of Technology. Announcement was made during the course of the evening of the elevation of T. A. Fearnside, Chief Mechanical Engineer of Stone & Webster to the rank of Fellow in ASME, and of the election of William C. White of Northeastern University to the rank of Fellow in AIEE.

Captain J. R. Dunford, USN, Deputy Chief of Naval Reactors Branch addressed the banquet and paid tribute to the contributions made by various land-based prototypes in the ultimate reduction in shakedown time required to render the atomic submarines *Nautilus* and *Seawolf* operational. In noting those areas in which the attitudes of the Navy toward nuclear power differ from that of the utility industry, Capt. Dunford stressed the fact that reliability for prolonged periods of continuous high power output took precedence over the value of greater efficiencies attendant to higher pressures and temperatures.

In discussing the sodium-moderated reactor, considered theoretically ideal in many quarters for marine application, Capt. Dunford observed that considerably heavier shielding is required. For this and other reasons, practical considerations may weigh against the sodium-moderated reactor in the building of tomorrows combat fleet of nuclear powered aircraft carriers, destroyers and the various types of submarines, all of which must be capable of operating for long periods at high speeds, completely independent of land bases.

Career Opportunities Unlimited

Registrants who assembled in Parlors B and C on Monday evening for the session devoted to Career Possibilities for Young Engineers in the Power Field again heard the future of the industry described in glowing terms by J. H. Keenan, Gordon Brown, J. A. Fay and G. N. Hatsopoulos, all of Massachusetts Institute of Technology, and by F. A. Kramer of Public Service Electric & Gas Co and V. F. Estcourt of Pacific Gas & Electric Co.

An examination of the full potential of careers just now being launched in the public utility field demands a glimpse of the future beyond the next 10 or 20 years, said Kramer. This long-term view reveals a far-reaching stride which we are certain to take before the end of the century: the generation of electricity by the hydrogen fusion process. Because these hydrogen-generation plants will be "fired" with sea water, fuel will have no cost and utility companies will probably base their rates on some measure of demand, with consumers being given every incentive to enjoy maximum benefit of energy delivered to him in off-peak hours.

In describing the public utility company of the future, Kramer noted that hydrogen-fusion generating stations will be clean, quiet and unlike nuclear-reactor plants, non-radioactive. In such a world the engineer is advanced to the high estate of an overseer of the automata that grind out solutions to his problems. To prepare engineers for these new accomplishments, our customary training in steam and power engineering will need to be broadened to an advanced and continuing education which will include a familiarity with physics, magnetics, electrostatics, servomechanisms, transient phenomena, strength of materials, metallurgy and electronics. This implies a career which includes advanced study, industry training and the wisdom of experience, all of which lead to areas of greatly expanded responsibility. Kramer concluded that public utility careers which start today will range far and grow steadily. THE END

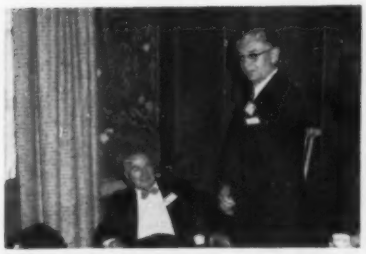


Fig. 8. C. R. Earle of POWER ENGINEERING and H. J. Petersen of United Engineers and Constructors enjoy a conference

Fig. 9. Bill Larkin, Air Preheater Corp with W. F. Ryan, Past President of ASME and Mrs. Larkin at a social

Fig. 10. Mrs. T. N. Graser, Ladies Committee, Mrs. L. J. Weed and Mrs. R. W. Worley, President, ASME Auxiliary

Fig. 1. General view of affected area with four tubes removed. Note studded tubes which form rear wall of furnace

Fig. 2. View of left hand pair of tube holes. Crack was 1¼" deep at lower edge and extended into drum metal at top

WHEN BOILER FAILURE CALLS FOR FAST ACTION . . .

Repair Your Cracked Boiler Drums by This Proven Method

By JOHN S. COLE*

OLD TIMERS IN THE RANKS of power engineers and boiler inspectors are familiar with the cause and repair of fire cracks in the girth seams of horizontal return tubular boilers, and in the furnace sheet seam of vertical tubular boilers. These cracks were invariably caused either by direct flame impingement on the seam, or insufficient conduction of heat away from a double thickness of metal exposed to direct heat.

Inasmuch as water tube boilers, in general, have no such seams exposed to direct heat, manufacturers of these units have for years claimed that fire cracks have been eliminated as a source of trouble. Similarly, the repair of fire cracks has become a lost art.

Recently, during the annual cleaning and inspection of one of a pair of 3-drum, bent tube water tube boilers, a severe case of fire-cracking was discovered in the fire side of the mud drum. This is a standard boiler operating at 900 psi and 750 F, and is rated at 120,000 pounds per hour. The furnace is water-cooled and is fired with both pulverized coal and #6 fuel oil as conditions dictate. It is normally operated at about 85 per cent of rating, or in the range of 100,000 pounds per hour.

Elevation of boiler and furnace is shown in Fig. 5. Fire cracks appeared in that area of the mud drum between the point where the rear water wall tubes enter the drum and the third row of generating tubes leave the drum. Figure 6 shows the manner in which water wall tubes and generating tubes were entered and rolled in the mud drum. It should be noted that the mud drum tube sheet was extra-thick at this point to maintain strength of the tube sheet ligaments.

Cracks Caused by Overheating

It is obvious that flame could impinge on this area at times when the boiler was operated near to or above rating. The possibility of local surface over-heating during normal operation due to poor conductivity between water wall tubes and outer skin of the drum is also apparent. As voids between water wall tubes and the mud drum filled with fly-ash, heat conductivity would be further decreased. Thus, conditions were ideal for the formation of fire cracks.

Figure 1 shows a general view of the affected area with two water wall and two generating tubes removed. Here the studded water wall tubes are clearly shown, together with the refractory backing which serves as the rear furnace wall.

An enlarged view of the right hand pair of tube holes with two of the cracks is clearly seen in Fig. 2. Figure 3 shows an enlargement of the left hand pair of holes. Here the crack extends completely across the tube ligament, and was 1¼ inches deep at the lower, or water wall tube hole. It also appeared to extend above the generating tube hole. The void between the tube sheet and the water wall tube shows clearly at the right hand edge of the picture, as does a minor crack extending up from this tube. A major crack is marked at the left side, extending above the water wall tube.

Many minor surface cracks show up in the picture, but as they disappeared with a minimum amount of surface removal, as shown in the ground areas of Figs. 4 and 7, they were not considered serious enough to require repair.

Repair Approval Necessary

Meeting was arranged between the chairman of the State Board of Boiler Inspection, the boiler manufacturer's field representative, the boiler insurance company's inspector and the author, as representative of the company owning and operating the boiler. Meeting was held to discuss the repair of this boiler and to obtain the necessary permission of the Board of Boiler inspection to proceed with repairs.

Decision was made to remove all tubes, both generating and water wall, from all holes showing major cracks. Cracks were then to be ground out until sound metal was reached, and then welded up. Welding procedure called for the drum to be preheated to 600 F, and then cooled slowly after welding to relieve all stress. Low hydrogen rod was used, and welding was done by a certified welder furnished by the boiler manufacturer.

It was also decided that both generating and water wall tubes could be stubbed. Accordingly, tubes in the affected area were cut in their straight lengths beyond the first bend. Stub lengths were ordered to replace these tubes after the drum

*Supt of Power Radio Corp of America, Camden, N.J.

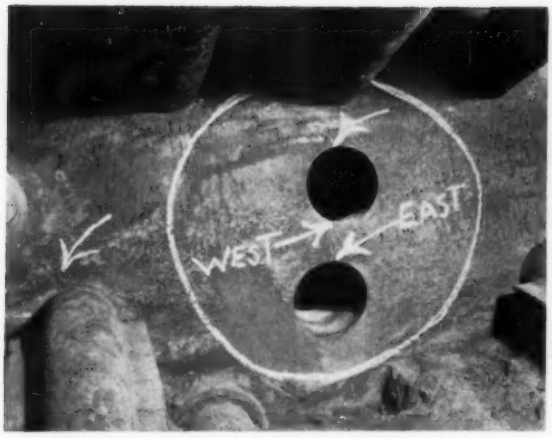


Fig. 3. Above. Enlargement of left-hand pair of tube holes. Crack extends completely across tube ligament and was 1¼ inches deep at bottom of hole

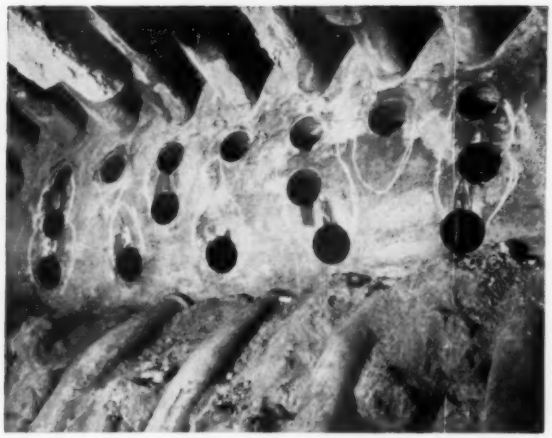


Fig. 4. Above right. Affected area of drum after tubes have been removed and cracks cut down to a good base

welding had been completed.

Figure 7 shows the affected area of the drum after tubes were removed and cracks cut out. This photo shows the right hand side of the drum when facing the drum from the furnace. Tube holes are in the center of the drum.

How Repairs Were Made

Grinding out of the cracks was done with a high-speed air turbine. Nylon cutting and grinding wheels were used.

After the drum had been preheated, welded and cooled, the reinforcing was ground off and tube holes reamed smooth. Stub tubes were installed, aligned and welded in place. Tubes were then rolled and flared in the drum. After the boiler had been tested hydrostatically, areas which had been affected were covered with insulating fire brick to prevent further flame impingement.

Two boilers in this battery were of the same age. It was therefore logical to expect that identical conditions would exist in the other unit. This proved to be the case and the fire cracks found were repaired in the same manner.

These cracks were discovered four years ago when the boilers were fifteen years old. During each subsequent annual inspection the refractory covering has been cleaned off and the repaired areas subjected to close inspection by the boiler inspector as well as our own power engineers. No further cracking has developed and we feel sure that the treatment, as described here, has been a success. THE END

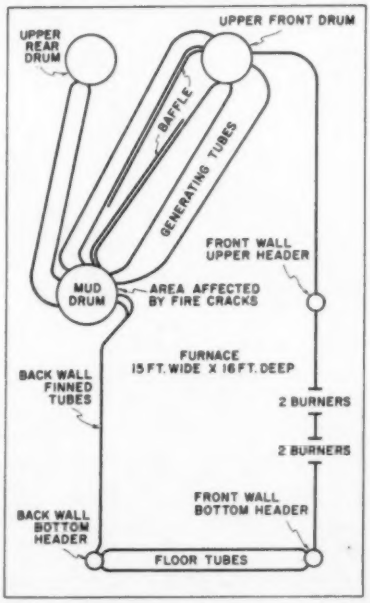


Fig. 5. Elevation of boiler and furnace showing crack location in drum

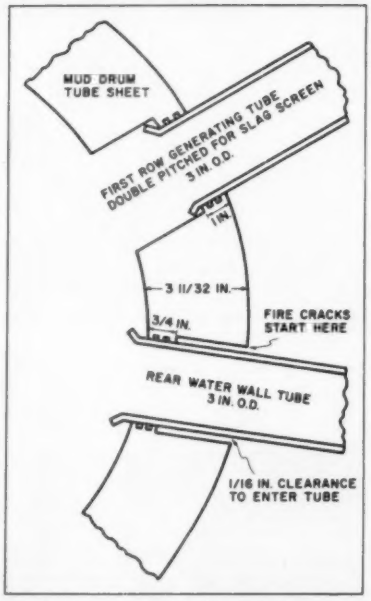

MUD DRUM TUBE SHEET
FIRST ROW GENERATING TUBE DOUBLE PITCHED FOR SLAG SCREEN 3 IN. O.D.
1 IN.
3 11/32 IN.
3/4 IN.
FIRE CRACKS START HERE
REAR WATER WALL TUBE 3 IN. O.D.
1/16 IN. CLEARANCE TO ENTER TUBE

Fig. 6. Sketch showing how tubes were entered and rolled into the mud drum

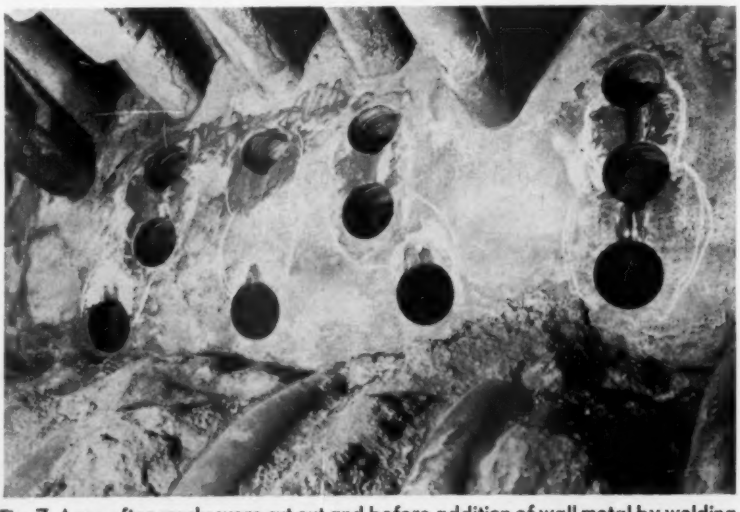


Fig. 7. Area after cracks were cut out and before addition of wall metal by welding

Power Engineering handbook

High Voltage Bushings Can Be Salvaged

By LLOYD McWILLIAMS

THESE PHOTOGRAPHS illustrate a method of reclaiming a broken 110-kv, porcelain, oil-filled wall bushing, with a resulting saving of several hundred dollars. Two such bushings were repaired and are presently in service on a 69-kv circuit.

Perhaps the most interesting feature in making this repair was the adapter device used to mount the bushing in the lathe for grinding. This cost very little, since it consisted of nothing more than a scrapped electric-steam-generator electrode that had become so badly eroded at its end that it was no longer serviceable. (On such jobs credit is due the old-time shop foreman who is ever on the alert to make do with makeshift tools.)

A large porcelain bushing is a most awkward piece to handle and can be mounted only by its flange; to set it up in a lathe called for a special device. The old boiler electrode proved ideal for this since its upper end had a diameter approximately the same as that of the bushing flange.

Since the electrode was much too long, it was first necessary to set it up in a lathe and part it to a length that would accommodate the upper end of the bushing (Fig. 3). Top section of the electrode was then removed from the lathe and drilled and tapped to suit the holes in the flange of the bushing. The mounting device was then returned to the lathe and the bushing mounted in the manner shown in Fig. 4. Fractured end of the bushing was ground to a smooth finish with a C-30-K8 B2 grinding wheel.

Final stage of such a repair is to attach the bushing terminal to the bushing. This will depend somewhat on the type and design of bushing; however, neolangite gaskets, with Heldite as the sealing agent, have proved to be ideal for attaching the terminal to the porcelain of the bushing.

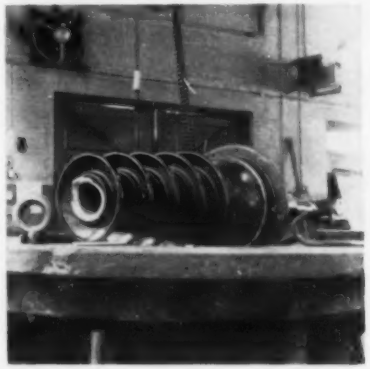


Fig. 1. When broken like this, 100-kv bushing can be repaired for service at lower voltage

Fig. 2. Old electric-steam-generator electrode was used as adapter for mounting in the lathe

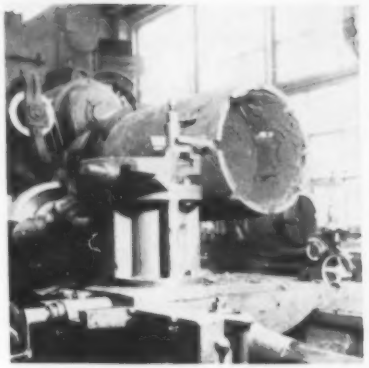


Fig. 3. Electrode after being parted to correct length. Note eroded condition of interior

Fig. 4. Bushing mounted in adapter during the grinding operation. Wheel used was C-30-K8 B2

Fig. 5. Close-up of repaired bushing; ½-in. steel plate was cut to size and drilled to accommodate the conductor and the terminal

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POWER ENGINEERING HANDBOOK

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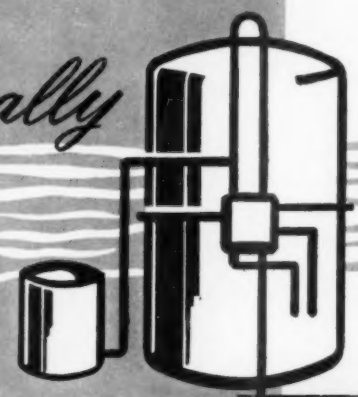
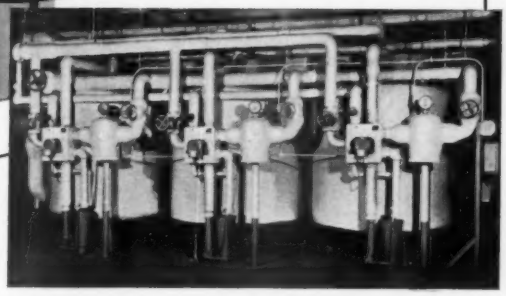
Progress in water conditioning . . .

soften water *Automatically* with a Cochrane sodium zeolite system





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Introduction to Steam Power

7—Boiler Feedwater Analysis

Course on power plant fundamentals developed by Commonwealth Edison Co for after-hours educational use. Next chapter, which will be the last, will discuss Feedwater Treatment.

Importance of Boiler Feedwater Analysis

1. All natural waters contain impurities: a. Suspended matter; clay, mud, sewage. b. Dissolved solids; mineral, salts. c. Dissolved gases; oxygen, nitrogen. d. Insoluble liquids; oils, soaps.
2. Feedwater impurities may enter the closed or condensing cycle in: a. controlled make-up; b. uncontrolled make-up (condenser leakage).
3. These impurities cause a number of difficulties in boiler and turbine operation: a. they affect the efficiency of operation; b. they will cause the deterioration of boiler and turbine equipment if not corrected.
4. Water must be analyzed to determine cause of difficulty: a. chemical or spectrographic analysis is necessary to identify impurities; b. study of the cause of the difficulty must be made before a remedy can be prescribed.

Difficulties Due to Improper Feedwater

1. Foaming and priming
   a. High concentrations of certain organic materials and suspended matter may cause foaming: 1. the organic matter may be of such a nature as to reduce surface tension of the water; 2. space above water is filled with bubbles.
   b. Priming is carryover of slugs of water with steam resulting from: 1. foaming; 2. pulsating steam demand that overtaxes steam storage; 3. operating boiler at too high rating; 4. insufficient disengagement area; 5. presence of water in the steam causes erosion of turbine blades and is a vehicle for carryover.
2. Carryover is the term applied to the continuous entrainment of a relatively small amount of boiler water solids with the steam.
   a. Regardless of feedwater treatment used, a certain amount of suspended and dissolved solids is present in boiler water.
   b. Rapid liberation of steam bubbles has a tendency to carry some of these solids out with the steam.
   c. This tendency is increased: 1. as rate of steaming is increased; 2. as concentration of solids in boiler water is increased; 3. by inadequate baffling of steam offtake.
   d. These solids deposit out on turbine valves and blading, resulting in loss of efficiency.
   e. Depending on nature of deposits, they may be removed by: 1. "washing" turbine with saturated steam (soluble deposits); 2. hand scraping or sand blasting of affected surface (insoluble deposits).
3. Scale formations
   a. Impurities present in feedwater remain in boiler when water is evaporated.
   b. As the concentration of the solids increases, some of them crystallize and may deposit on tubes in the form of scale.
   c. Effect of scale: 1. reduces heat transmission by acting as an insulator; 2. causes overheated or burned-out tubes.
4. Corrosion and pitting
   a. Some of the impurities in the water act upon the metal of the boiler.
   b. These impurities are in the form of acids, gases, or some salts.
   c. Tubes of the boiler become pitted and will eventually fail if not replaced.
5. Embrittlement
   a. Certain other impurities have the property of attacking the metal of the boiler at points where it is under a severe strain.
   b. In this case the physical characteristics of the metal are changed, causing brittleness.

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Chemical Definitions

1. *Elements* are substances that cannot be further decomposed by chemical methods.
   a. The 96 elements are the basic chemical material in their most simplified form.
   b. Hydrogen, sulfur, and calcium are examples of elements.
2. *Atoms* are the smallest particles into which elements can be divided and still retain their identity as elements. They are the smallest unit of matter remaining unchanged in chemical reactions.
3. *Molecules* are the smallest particles which retain the properties of substance in question, such as C, H_2, CO_2. They are a combination of atoms of one or more elements.
4. Compounds are chemical combinations of whole atoms of two or more elements.
   a. The compound formed is a new substance.
   b. Hydrogen and oxygen combine chemically to form a molecule of a new compound, H_2O.
5. A *mixture* is an intermingling of two or more materials without being chemically transformed. Garden soil is a mixture of sand, clay, and humus, which can be separated.
6. An *ion* is an electrically charged atom or it can be a group of atoms called a *radical*. This charge may be positive or negative.
7. The *valence* of any ion (positive or negative) is the number of charges (electrical "hooks") it carries.
8. If any metallic positive ion combines with a negative OH ion, a *base* is formed. NaOH, sodium hydroxide (caustic soda), is a base.
9. If a hydrogen ion combines with any negative acid radical, an *acid* is formed. HCl, hydrochloric acid, is an acid.
10. If any metallic positive ion combines with any negative acid radical, a *salt* is formed. NaCl, sodium chloride (common table salt), is a salt.

Chemical and Physical Properties of Water

1. Water is a chemical combination of the two gases hydrogen and oxygen.
   a. Chemical symbol for water is H_2O.
   b. Chemical formula for the formation of water is:
      $2H_2 + O_2 \text{ ——— } 2\ H_2O$
      Four atoms of hydrogen combine with two atoms of oxygen to form two molecules of water.
   c. Pure water is neutral, that is, neither acid nor alkaline. Only by the additions of other chemical elements does water become basic or acid. An *acid* water is one which contains a greater number of hydrogen ions than neutral water. Something has been added to cause the acidity. An *alkaline* water is one which contains fewer hydrogen ions than a neutral water. The addition of some alkaline substance would result in this.
   d. The degree of acidity or alkalinity of water is measured in terms of the amount of hydrogen ions present and is referred to as the "pH" of the water. 1. The pH of neutral water is 7.0, of an acid water is less than 7, and of an alkaline water is greater than 7. 2. pH measures the *effective* acidity of alkalinity of the water, not the total quantity present. 3. The pH value of a water is determined by adding small amounts of certain chemical indicators to samples of the water and comparing the resulting color with standards.

Chemical Analysis, Feedwater Difficulties

1. Chemical compounds that cause scale formation
   a. Calcium sulfate and carbonate are chief causes of scale formation in boiler.
   b. Magnesium sulfate and carbonate: the character of a magnesium scale is not quite so hard as that of a calcium scale.
   c. Silica when combined with aluminum salts forms an extremely hard scale in boilers.
   d. Calcium and magnesium bi-

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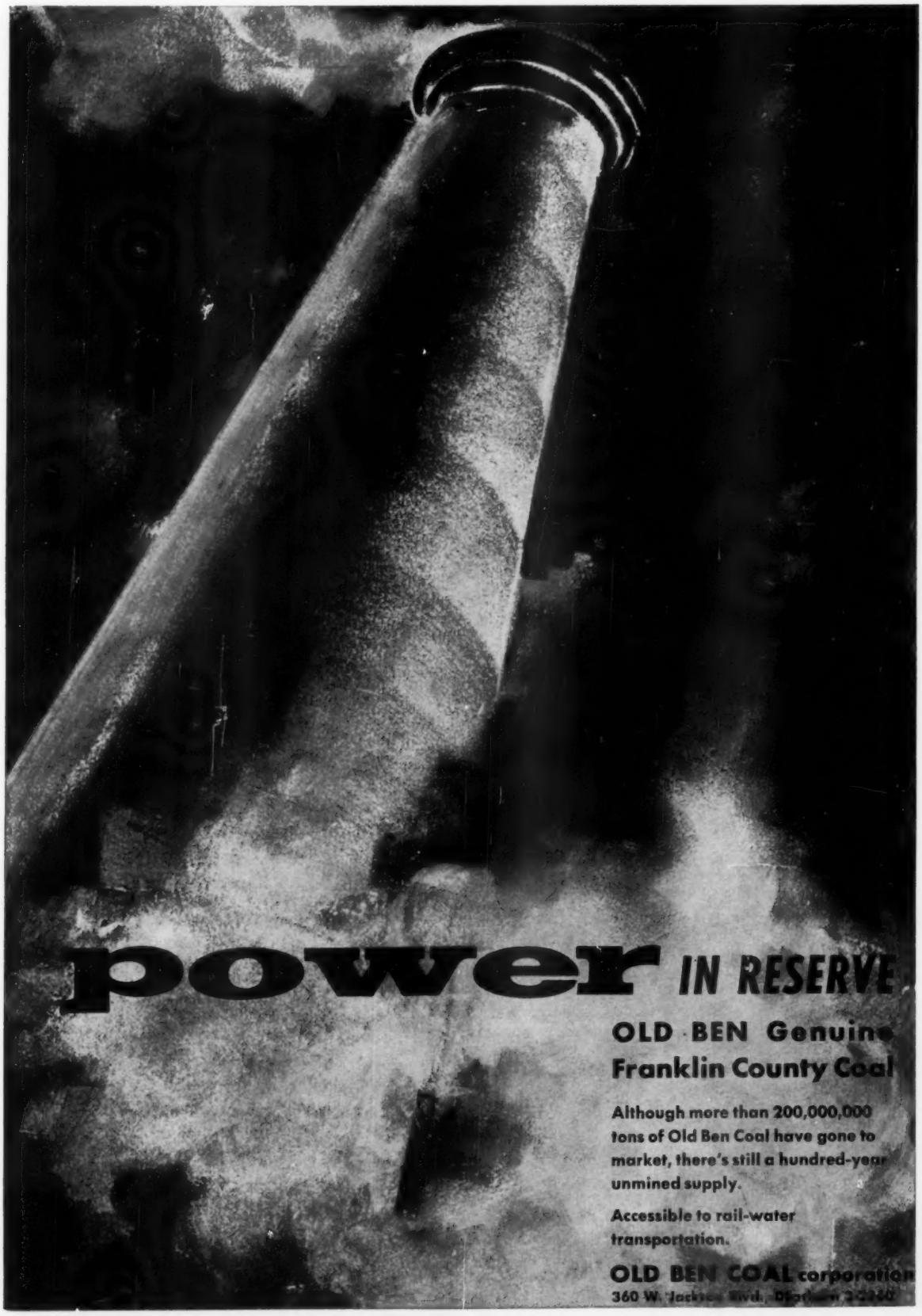
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carbonate: 1. causes a temporary hardness, breaks down under influence of heat to form carbonate; 2. carbonate precipitates from solution to form scale.

e. Oxides of iron and aluminum generally do not form a hard scale, unless accompanied by considerable silica.

2. Cause of corrosion and pitting
   a. Electrolytic theory: 1. Iron has a tendency to go in solution and it increases with the hydrogen ion concentration. 2. As the hydrogen ions plate out, additional amounts of iron go into solution. 3. Hydrogen ions plating out form a gaseous film which stops action until hydrogen film is removed. 4. Dissolved oxygen present reacts with the hydrogen forming water and the action repeats.
   b. Presence of gases in water affects the rate of corrosion.
   c. Acids or acid-forming salts contribute to corrosion.
3. Cause of embrittlement
   a. There are three factors necessary to produce intercrystalline cracking of boiler: 1. leakage of the boiler water must take place so as to permit escape of steam and concentration of the boiler water at the point of leakage; 2. boiler metal must be subject to high stress; 3. concentrated boiler water must possess embrittling characteristics and chemically attack boiler metal.
   b. Inasmuch as all three factors of leakage, stress, and embrittling character of the boiler water are required for the production of intercrystalline cracking, if it can be definitely shown that one of these three factors is absent, it can reasonably be assumed that the danger of embrittlement is non-existent in that instance.

Air Pressures in Sprinkler Tanks

By JOHN D. CONSTANCE, P.E.

WHEN APPROVED fire sprinkler systems with pressure tanks as a single source of water supply are a part of such installations, it is often necessary to keep an eye on the air pressure vs water quantity in the tank. For instance, the minimum amounts of available water supply depend on the three types of occupancy according to the Standards of the National Fire Protection Assn.

1. *Light Hazard Occupancy:* amount of available water shall be not less than 2000 gal. This is typical for hospitals, public buildings, etc.

2. *Ordinary Hazard Occupancy:* amount of available water not less than 3000 gal. This is typical for boiler houses, power plants, canneries, etc.

3. *Extra Hazard Occupancy:* amount of available water supply depends on special considerations as determined by authorized persons having jurisdiction.

The Standards point out that the preference is for the tank to be above level of uppermost sprinkler head (curve 1 on the graph). Ordinarily, pressure tanks are kept two-thirds full of water or one-third of air. If approved otherwise, air portion may vary and there is a definite relation between water volume in tank vs air pressure to be maintained, as set down by regulation. This relation is depicted by the formulas shown on the graph. Under these conditions there is assurance that the last gallon of water leaving the tank when in any position is at a minimum pressure of 15 psig.

When highest sprinkler head is above the bottom of the tank, an additional pressure equivalent to a hydrostatic head corresponding to the vertical distance between the base of the tank and the sprinkler is required (curves 2, 3, and 4 on the graph).

The family of curves gives a quick visual appreciation of the variables involved and provides the operator with quick answers.

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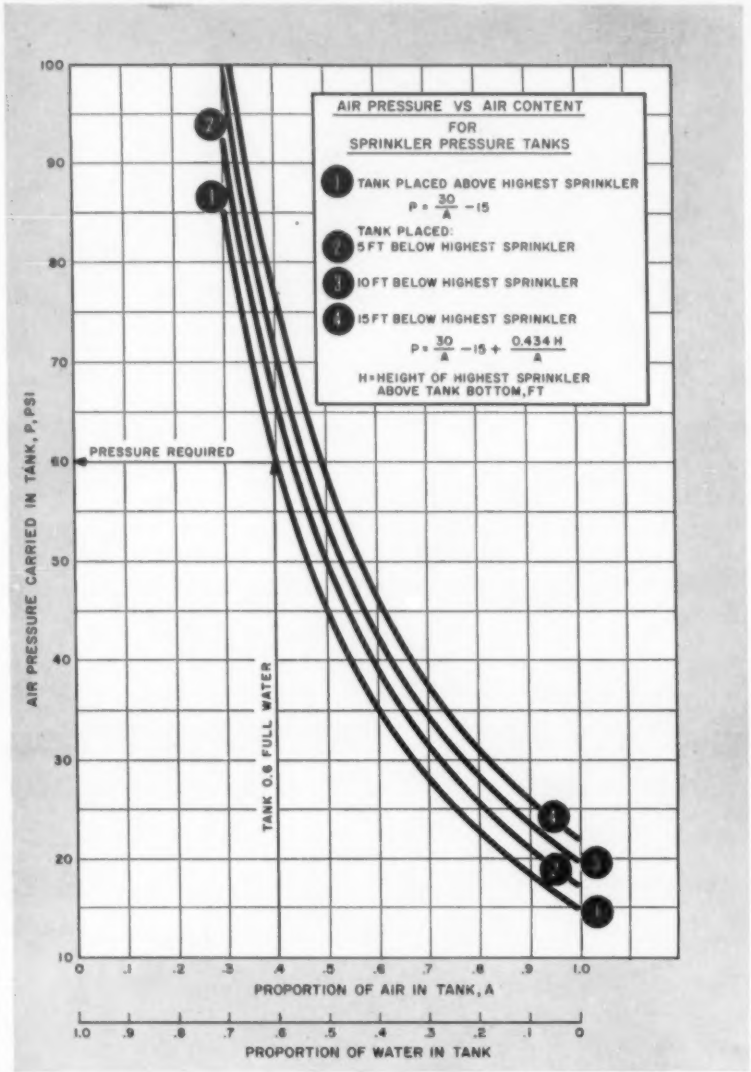
AIR PRESSURE VS AIR CONTENT
FOR
SPRINKLER PRESSURE TANKS
1 TANK PLACED ABOVE HIGHEST SPRINKLER
P = 30/A − 15
TANK PLACED:
2 5 FT BELOW HIGHEST SPRINKLER
3 10 FT BELOW HIGHEST SPRINKLER
4 15 FT BELOW HIGHEST SPRINKLER
P = 30/A − 15 + 0.434 H/A
H = HEIGHT OF HIGHEST SPRINKLER ABOVE TANK BOTTOM, FT
PRESSURE REQUIRED
TANK 0.6 FULL WATER
AIR PRESSURE CARRIED IN TANK, P, PSI
100
90
80
70
60
50
40
30
20
10
0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0
PROPORTION OF AIR IN TANK, A
1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0
PROPORTION OF WATER IN TANK

Family of curves gives quick picture of variables involved and can provide operator with quick answers

POWER ENGINEERING HANDBOOK

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Bailey Controls for Combustion, Feed Water and Steam Temperature at the St. Clair Power Plant of Detroit Edison Company. The FPC reported a 1956 heat rate at St. Clair of 9,200 Btu per kwhr, making it the sixth most efficient plant in the United States.

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***6 MOST EFFICIENT PLANTS—1956 Heat Rates Reported by FPC**

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1. Tanners Creek (Indiana and Michigan Electric Company)	9,106	B	B	B	B
2. Kanawha River (Appalachian Electric Power Company)	9,115	B	B	B	B
3. Kyger Creek (The Ohio Power Company)	9,176	B		B	B
4. Muskingum River (The Ohio Power Company)	9,176	B	B	B	B
5. Clifty Creek (Indiana-Kentucky Electric Company)	9,200	B	B	B	B
6. St. Clair (The Detroit Edison Company)	9,200	B	B	B	B

A140-1

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How to Maintain Stuffing Boxes That Have Mechanical Seals

By J. A. CABLE
and O. M. KRISTY,*

Last month these experts began a Handbook discussion of proper maintenance for centrifugal pumps. Chapter 1 concentrated on stuffing boxes fitted with packing. Next time, the spotlight will be on shafts and sleeves

MECHANICAL SEALS, like packing, will perform better and be easier to maintain *if* they are properly chosen in the first place. Since the parts of seals are quite small compared to the pump in which they are installed, the choice of construction materials for handling various liquids is too complex a subject to be included here. If you want to handle liquids with corrosive properties, consult a seal manufacturer directly or ask the pump manufacturer for specific advice.

Mechanical seals, unlike packing, should not leak when properly applied. They should be lubricated; so to select a seal properly and determine how it will be installed, the pump supplier must know the pressure differential across the stuffing box and all possible variations of this pressure if it is not constant. To have a margin of safety, it is usually agreed that positive pressure of about 5 psig minimum will allow the seals to receive sufficient lubrication from the product pumped. The pumped liquid will naturally recirculate through the seal cavity from the in-board end of the stuffing box as at A in Fig. 1.

Figure 2 shows a mechanical seal fitted box which should be used when the pressure across the box is under 5 psig down to 25-28 in. Hg. The tap A in the upper wall of the box should be fed under pressure to assure seal lubrication and the feed must be slightly more than the possible leakage through the in-board annulus B. This liquid may come from the pump when the liquid handled has lubricating properties or from an outside source when pumping non-lubricants. This type of seal can also be used when pumping fluid containing solids in suspension.

For more perfect vacuums a double seal (Fig. 3) makes for a better installation, and it must be lubricated from an outside pressurized source. With a double seal the stuffing box cavity usually must have in and out seal lines (in at the bottom, out at the top) so that the sealant can flow through the seal cavity in sufficient quantity to cool the seals.

* Application engineer and supervisory engineer, respectively, Centrifugal Pump Dept, Allis-Chalmers Mfg Co

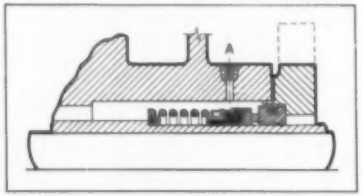

Fig. 1. The pumped liquid recirculates through seal cavity A, from in-board end of the box

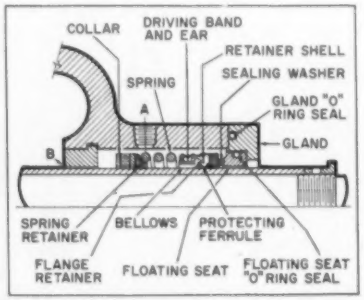

Fig. 2. This arrangement should be used when pressure across the box is under 5 psig down to 25–28 in. Hg. This type of seal can also be used for fluids with solids in suspension

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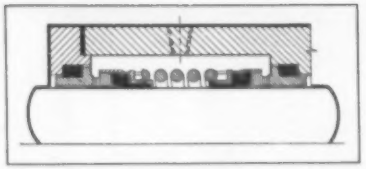


Fig. 3. For more perfect vacuums a double seal is better, must be lubricated from outside source

When pumping cold liquids under these vacuum conditions it can suffice to maintain just a small container of sealant located above the stuffing box, with a good sized line connection to the seal cavity. The seals will cause enough movement of the liquid to keep temperatures within safe limits without forced circulation. This will only work with cold liquids and the quality will vary with seal size and product temp.

Double seals are also ideal for pumps handling solid-laden liquids. Here, however, sealant pressure must be used of at least 5 psig over highest possible pressure on the inboard end of the box.

For both vacuum and slurring pumping keep the sealant pressure on whether pump runs or not.

Standard mechanical seals are usually limited to a maximum pressure range (this is differential across the stuffing box, not necessarily pump developed head) up to 100 or 200 psi varying with different seal suppliers. Beyond this range, balanced seals are available to seal pressures up to 550 to 750 psi. Generally, seals ought to be your first choice when pressures exceed 75 psi with any neutral products, and for all pressures when pumping toxic and inflammable liquids.

Temperature is another general limiting factor. The various standard seals use rubber or synthetic parts and −40 F up to 212 F is the range for their operation. On hotter temperatures (to 400–500 F) sealing is possible using a tetrafluorethylene plastic for the flexible members.

Installation Precautions

Protect all flexible members, as well as the seal faces. When passing the flexible members over sleeves, shafts, nuts, etc, cover threaded areas with paper or tape before sliding seal parts past, and check to be sure all burrs are removed and a small radius exists on the shaft sleeve ends. A light film of oil on sleeve surfaces will help greatly.

Check position of set collar, if used, to be sure that seal is confined to predetermined length when installed. When fitting single suction pumps with rubber bellows-type seals only, slide bellows on until it contacts its spring mechanism so that final step of mounting rotor in casing and tightening gland plate will push bellows to proper position. (*Don't stop to eat lunch half way through this job.*) Bellows will adhere to shaft in position thus established and seal relies on bellows to prevent leakage between itself and the shaft or sleeve.

With double suction pumps, the seals have to be first put on the rotating element, and later on, this element is assembled in the casing. This can require too much elapsed time before the gland plates can be pulled into position. Therefore it is well to make up a split collar to use instead of the gland plate, to position the seals while assembling on the rotating element. These collars are then removed and the gland plates pulled up when the element is assembled.

Mechanical seals are one item which should not be submitted to routine inspection maintenance. In operation the seal faces "wear in" with respect to each other, and if disturbed, it may not be possible to get them reseated. It is good practice to maintain a set of spare seal faces so that when pump maintenance causes the seals to be moved to get at other parts of the pump, these faces can be replaced.

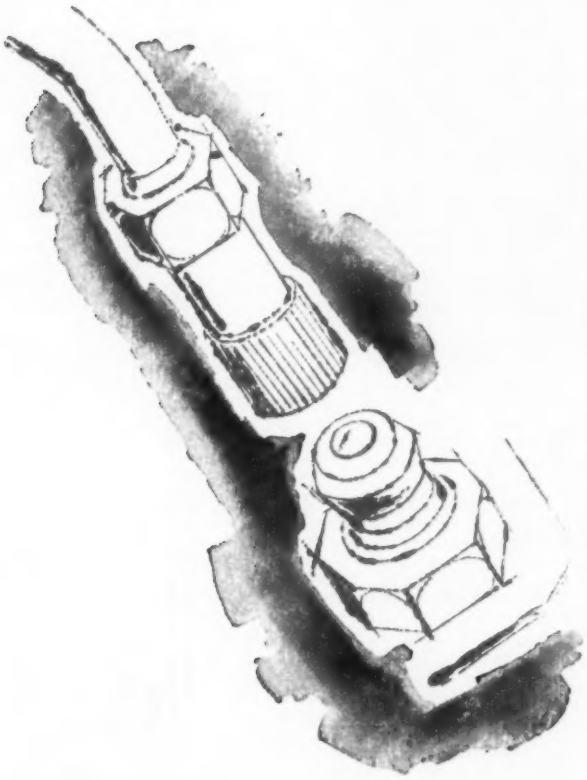
Used faces can be relapped if returned to the seal supplier. The economy of this will depend on how special or large the seal may be. Roughly, if the seal is over 2 in. in size, relapping gets practical.

Also, if the seal is of the bellows type, spare bellows ought to be kept on hand.

A closing word about seals: insist that their lubrication be kept constant, clean and cool. Pressure must be slightly more than the differential across the seal. The seal liquid must have lubricating properties.

By keeping the sealant below 160 F, seals will last longer even though manufacturers okay their application in up to 212 F water.

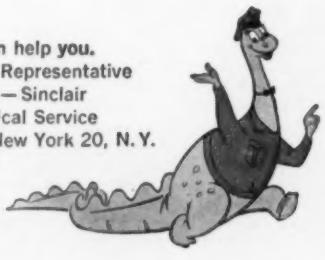
cut along this line



Machinery... lubrication... and how to save money

Sinclair Litholine® multi-purpose grease gives many important advantages over ordinary industrial lubricants. For example, it eliminates the need for a variety of single-use greases. Furthermore, it has earned a reputation for water resistance and high temperature performance. Change to Litholine, now. And when management asks how you've cut costs, tell them you've switched to Sinclair—and show them the results.

Find out how Litholine can help you. Call your nearest Sinclair Representative or write for free literature—Sinclair Refining Company, Technical Service Division, 600 Fifth Ave., New York 20, N.Y. There's no obligation.



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CONSTRUCTION NEWS

Anchorage, Alaska — Chugach Electric Assn, has approved plans for the construction of a large earth-filled dam across Cooper Creek in conjunction with construction of Cooper Lake Hydroelectric project reported to cost in the neighborhood of $14,000,000. Work to begin soon will include a power tunnel, a 15,000-kw hydroelectric generating plant with empty stalls for later expansion when necessary to 30,000 kw. Company also plans installation of about 160 miles of high voltage transmission lines.

San Francisco, Calif. — Pacific Gas & Electric Co, 245 Market St, has work under way on the construction of a large nuclear power plant at Humboldt Bay, on the northern California coast, just south of Eureka. Plant will have an initial capacity of 60,000 kw when completed in 1962, and will represent an investment in excess of $20,000,000. Company also has plans under consideration to have at least one 200,000-plus kw capacity nuclear power plant in operation within its northern and central California system by 1965. Big West Coast utility has previously announced its intent to build additional atomic facilities, but has never before released details as to their size.

Middletown, Conn. — Hartford Electric Light Co, 266 Pearl St, Hartford, Conn., has authorized plans for the construction of a concrete and steel transformer building here. Work on the new facility will begin soon for completion by late 1959. Cost, including installation of transformer, reported to be in excess of $100,000.

Norwich, Conn. — State Public Works Dept, 165 Capitol Ave, Hartford, Conn., has awarded contract to the Connecticut Boiler Heating and Plumbing Co, for boiler house addition, including piping and auxiliary equipment, at Norwich State Hospital here. Work when completed will cost approximately $150,000.

Arco, Idaho — Atomic Energy Commission, Idaho Operations Office, Idaho Falls, Idaho, has announced plans for the construction of power plant and cooling tower, and completion of experimental Breeder Reactor II plant building at National Reactor Testing Station, located here. Plans include completion of building, utilities, and other facilities reported to cost in excess of $3,000,000. Work on the facility is already under way and is scheduled for completion by early 1960.

Spencer, Iowa — City of Spencer, Iowa, City Hall, has announced contract award to the Spencer Construction Co, for major addition to city's municipal power plant. Work to begin at once under supervision of Stanley Engineering Co, engineers, at a reported cost of $407,000.

Hill City, Kan. — Central Kansas Power Co, Hays Div, 111 E 11th St, Hays, Kan., has awarded contract to the Babcock & Wilcox Co, for the construction and erection of 215,000-lb high-pressure boiler and auxiliary equipment in connection with construction of new power plant here. Plant will have an initial capacity of 22,000 kw and will cost approximately $6,000,000, when completed in 1960. Company plans a long lease to Sunflower Electric Coöperative, Wakeeney, Kan., who will operate the plant. Construction work is under the supervision of Black & Veatch.

West Springfield, Mass. — Western Massachusetts Electric Co, 45 Federal St, Greenfield, Mass., has authorized plans for the construction of new building on Brush Hill Ave. New facility will be used as system headquarters building and for administrative offices of the company. Aquadro & Cerruti, Inc, has been awarded the construction contract reported to be in excess of $1,600,000. Work will begin soon for completion by early 1960.

Jackson, Mich. — Consumers Power Co has approved plans and will start construction at once on the first 265,000-kw unit of a new steam-electric power plant to be located on Lake Michigan, at Port Sheldon. Allis-Chalmers Mfg Co will produce the steam turbine generator. The boiler, which will consume 750,000 tons of coal annually, will be built by Combustion Engineering Co, Inc. Preliminary engineering work and clearance of the plant site is already under way. Plant will be in operation by the fall of 1962, according to present schedules.

Lesterville, Mo. — Union Electric Co, of Missouri, 315 N 12th Blvd, St. Louis, Mo., has plans under consideration for the construction of a pumped storage type hydroelectric power plant on large building site here. Power plant will include construction of two dams across the Black River and Tom Sauk Creek and will cost an estimated $30,000,000 when completed. Work will begin soon, under supervision of Sverdup & Parcel, Inc, for completion in late 1962.

Bow, N. H. — Public Service Company of New Hampshire, 1087 Elm St, Manchester, N. H., has announced plans for contract award to Sanders Construction Co for the construction of a large new steam-electric generating station here. New facility will begin at once under supervision of Jackson & Moreland, Inc, and will represent an investment in excess of $24,500,000.

Somerset, N. Y. — New York State Gas & Electric Co, 123 S Cayuga Ave, Ithaca, N. Y., has announced plans for the construction of new power generating station here. Total cost of the work, which will include installation of steam-electric generating unit with auxiliary equipment, is reported to be in excess of $2,000,000. Work on the new facility will begin at once, for completion by early 1960.

Norristown, Penna. — General State Authority, 18th and Herr Streets, Harrisburg, Penna., has announced alteration plans for work on old boiler plant, for central stores and shops at Norristown State Hospital. Work which will begin at once, is reported to cost about $400,000. Sanders & Thomas Associates are architects and engineers of the project.

San Juan, P. R. — Puerto Rico Water Resources Authority has awarded a contract to the Kaiser Engineers Puerto Rico, Inc, for the construction of a steam-electric generating station, near here. Construction of the station and installation of equipment for two steam electric generating units, each with an initial capacity of 82,500 kw, will get under way soon, for completion by late 1961. Construction of the new plant is part of a $76,400,000 program by the Water Resources Authority that will approximately double Puerto Rico's present generating capacity of 360,000 kw by late 1962.

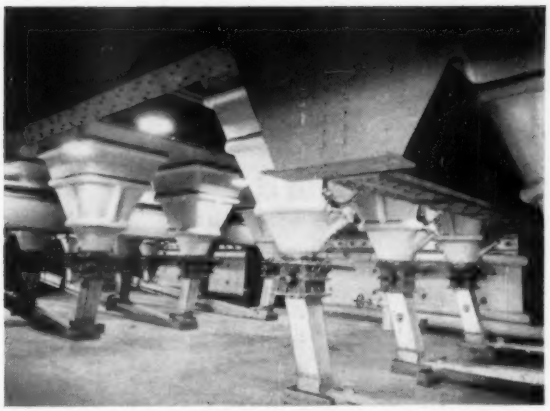
Lynchburg, Va. — The Atomic Energy Commission, 1901 Constitution Ave, NW, has approved plans to issue a permit to Babcock & Wilcox Co for the construction of a low power research reactor. The reactor, a pool type designed to operate with power levels up to 200 kw, will be built at company's plant located near here. Facility will be used to obtain design information for a liquid metal fuel reactor experiment, which is to be designed, built, and operated by Babcock & Wilcox Co. Work will get under way at once for completion by early 1960. No estimate of cost available.

Roanoke, Va. — Appalachian Power Co, 129 Campbell Ave, a member of the American Electric Power System, has plans under consideration for the construction of a $45,000,000 Smith Mountain Combination Project on the Roanoke River. Proposed project, to consist of two adjoining developments will have a total installed capacity of 320,000 kw and will be the largest hydroelectric power plant in the state. Construction will begin at once and the project is expected to take about three years for completion. Development includes an upper dam 235 ft high to be constructed at the Smith Mountain gap on the Roanoke River and a lower dam 90 ft high to be built at a site about 17 miles below the upper dam and a few miles above Leesville, Va.

Cresap, W. Va. — Ohio Power Co, 301 Cleveland Ave, SW, Canton, Ohio, has announced that the first of three 225,000-kw generating units at company's Kammer Station was placed in line. New power station here, about 10 miles upstream from Ormet Corp and owned jointly by Olin Mathieson Chemical Corp and Revere Copper & Brass Inc, will supply electric power for the aluminum reduction plant now under construction. Kammer Station, which has installed the first commercial char-burning boilers developed by Babcock & Wilcox, Inc, will be integrated into American Electric Power Corp's seven state grid, — an industry-utility arrangement similar to that between Public Service Electric & Gas Co and Esso's Refinery.

Alma, Wis. — Dairyland Power Coöperative, 2615 East Ave, La Crosse, Wis., has plans under way for new addition to steam-electric power plant located here. Work will include installation of unit No. 5 steam-electric turbine generator, high-pressure boiler and auxiliary equipment. G. Arnold, Inc has been awarded the construction contract reported to be approximately $515,000.

How Commonwealth Edison Turned a Fly Ash Problem Into Profit



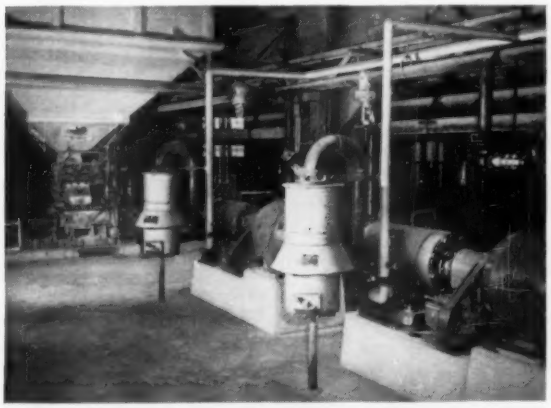
F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

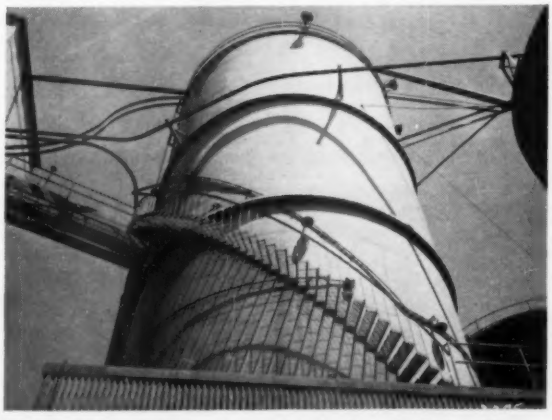
Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash for sales to local contractors.

Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

1335
G-203

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EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 105–106 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—RAPPER CONTROL adjusts to fit collection requirements

Full-Range Rapper Control is a system designed to permit adjustability of rapping frequency, intensity and patterns (number and sequence of blows delivered by each rapper) to fit virtually any dust collection requirement. The control can be dialed to give a cycle as fast as a complete rapping every 50 sec or as slow as one every 3½ hr, or any desired time interval between these limits. Degree of rapper impact is adjustable from zero to maximum over a wide operating range, and the number of impacts per rapping cycle (two, four or eight per cycle) can be adjusted as required. With a variable rapping cycle, the first blow is soft to remove only heaviest accumulation, and each successive one stronger until maximum pre-set impact is reached. Other advantages announced for this rapper control include low voltage operation, electronic timing circuit, unitized circuitry. Western Precipitation Corp.

2 — THAWING UNITS ease frozen carload dumping

Placed in two rows under the cars and a row along each side, Hot Dogs thaw loads for dumping, with heat transferred by rapid radiation from the glowing units and flow of hot gases escaping through holes along their tops. Operating costs (fuel and labor) are claimed

as low as 4 cents per ton of coal dumped, and capital outlay is reduced by rapid heating which permits use of a windbreak instead of an enclosure. The Hot Dogs have been placed on a "bun" of weather resistant refractory, which protects railroad ties without additional insulation, and which directs even more heat toward the car once the refractory becomes hot. The unit may also be fired with light oil or with gas, including propane or bottled gas as well as natural or coke gas. The North American Mfg. Co.

3—AIR DISTRIBUTORS can serve up to 16 separate zones

For air blending in multi-zone applications, Series 1600 Air Distributing Units include basic sizes for capacities of 4000 to 34,000 cfm, with units made to handle up to 16 zones. They are blow-through type with outlet divided to serve either cooled or heated air or controlled mixtures of the two to each zone. The number of zones which can be served by a single unit varies with the unit size. All sets of dampers are interconnected with a single, continuous external connecting rod which can be cut in the field to suit the required number of zones. Individual zone control is then obtained by separate modulating damper motors. Sturtevant Div., Westinghouse Electric Corp.

4—CONVERSION KIT provides increase in current ratings

This kit is introduced for converting ampere ratings of all of manufacturer's high voltage tilting insulator switches — making it unnecessary to replace entire switches when increasing line current. Switch conversion is claimed both easy and inexpensive because it can be made without removing switch from its mounting. With the kit, 200-amp 2ST or 3ST tilting insulator switches can be converted to either 400 or 600 amp. Switches rated at 400 amp can be increased to 600 amp. The conversion is possible because each of these switches — except for the jaw assembly — is designed to meet NEMA standard for 600 amp. The ST switches use multiple beryllium copper jaw contacts — each rated at 200 amp. Uprating a switch from 200 or 400 amp is done by mounting additional 200 amp jaw contacts on the pre-drilled jaw terminal plate. Switches are available in voltages from 7.5 to 34.5 kv. I-T-E Circuit Breaker Co.

5—REGULATOR combines magnetic, electric amplifiers

Bulletin 5100 Type GS is an all-purpose two-stage regulator combining features of magnetic and electronic amplifiers. Electrically isolated inputs, compactness and minimization of drift are announced for it. The regulator will be applied on adjustable-voltage d-c drives and other applications for voltage and current regulation in speed, tension, position and similar systems. This regulator has a magnetic amplified control input stage and a grid-controlled rectifier power output stage. A "grid switching" circuit controls output rectifiers.

Reliability and long life virtually free of maintenance are claimed. The basic regulator is made as a compact and complete unit. Each of four principal components: exciter unit (power), grid switching unit (control), reference unit and time delay unit are unitized and potted in individual steel drawn enclosures. Three sizes are available: 5 amp maximum, 12.8 amp maximum, and 36 amp maximum with intermediate ratings available. Clark Controller Co.

6—ELECTRONIC RECORDER is two-pen, miniature unit

This all-electronic two-pen instrument records two variables on a single chart, permitting one-glance checks of a pair of related variables, as well as saving panel space. As an optional feature, the recorder can be furnished with a control set point, or alarm contacts, or both, for one of the variables. This recorder fits a 5-in. square panel cutout and is housed in standard 24-in. deep panels. Most parts are interchangeable with com-

pany's single-pen recorders. The unit contains two separate but identical signal amplifiers and pen-actuating mechanisms on a single chassis. An interlocking arrangement is provided to keep the recorder from being removed from the case while the power is on. Specification A805 gives further information on the instrument. Swartwout Co.

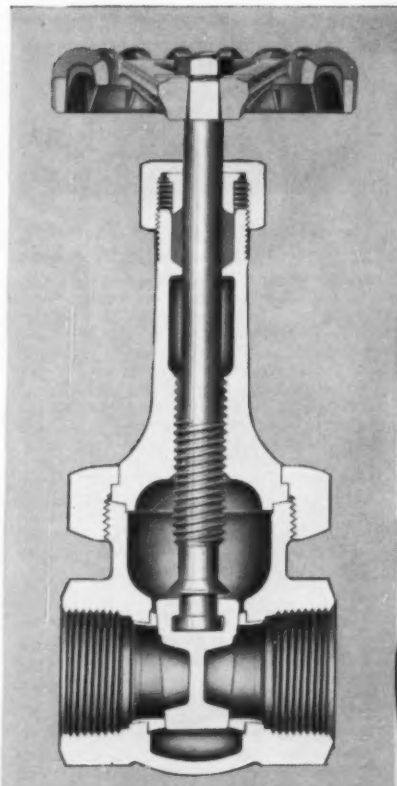
7—HYDRAULIC PIPE CUTTER for various types of pipe

This heavy-duty hydraulic pipe cutter is designed to cut cast iron water main or cement-lined cast iron water main from 4 to 12 in., standard or extra-heavy soil pipe from 6 through 15 in., terra cotta or

clay tile from 6 through 36 in., and transite pressure pipe from 6 through 10 in. To operate, chain is wrapped around pipe and pulled through jaws to nearest ring. Adjusting screw is tightened to take up slack and hydraulic pressure applied by hand or electric pump. Operator gets a clean, accurate cut in less than one minute, company says. Cutter requires no vice or turning, it is said — can cut pipe in a ditch, in a line, or anywhere that chain can be wrapped around pipe. Wheeler Mfg. Corp.

8—SCANNING CONTROL can monitor up to 24 stations

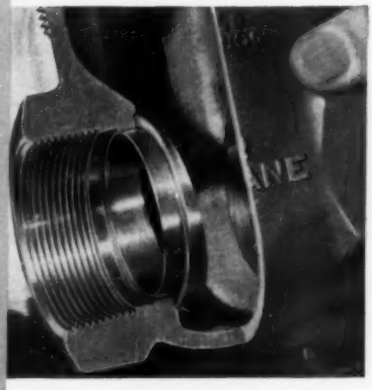
With this scanning control as many as 24 stations may be monitored in sequence, any abnormal condition being instantly indicated by a red light on the control and by an alarm, if desired. In addition, the equipment being monitored may be shut down. Although developed for monitoring temperatures from −200 to 3000 F, the scanner will provide similar protection with most other measurable variables. The only restriction is that all stations have the same permissible limits of the condition being monitored. Either high or low limits, or both, are set on a single meter-



COMPLETELY NEW—loaded with improved service features inside and out. Two complete lines: rising stem pattern (No. 634E—cross section shown), non-rising stem (No. 636E)—both in sizes ¼ to 3 in. incl., with screwed ends. See below for literature.

NEW CYLINDRICAL BODY SHAPE—a proven design on high-pressure steel valves—increases strength without added bulk, distributes pressure load uniformly, resists distortion and leakage at seats.

NEW, STRONGER HEX ENDS, better integrated with body, eliminate sharp contours, give entire valve more rigidity under line strains. Wider hex faces allow firmer wrench grip for easier installation. Marring less likely.



NEW, EXPANDED-TYPE BODY RINGS insure long, tight-seating service life. They're rolled in, can't work loose. Shoulder at bottom of end threads restrains excessive entry of pipe against possible seat damage.

NEW EXELLOY, 12% chromium steel body rings give a hard bearing surface, highly resistant to wear, indentation, scoring and foreign matter damage. Easily replaced bronze disc takes the brunt of normal wear.

New design for tough service...easy maintenance

300-Pound Wedge Disc Bronze Gate Valves

Rising Stem and Non-Rising Stem Patterns

A new body shape that distributes greater strength uniformly against internal stresses and external strains . . . better integrated hex ends, huskier and wider, that add to body rigidity and give a firmer wrench grip . . . new rolled-in, high wear-resisting alloy body rings that don't work loose . . . easily renewed wedge disc—these are typical important features of new Crane bronze gate valves.

On your toughest services, these valves assure ultimate durability . . . new ease of application . . . low-cost repairability. And they're priced no higher than ordinary 300-pound integral seat bronze valves.

Easy to Repair—The Disc Takes the Wear

After long, hard service the hard Exelloy (12% chromium) body rings show no appreciable wear. Normal seating wear is taken by the bronze disc. When needed, a new disc, easily slipped onto stem, provides a practically new, tight-seating valve.

Circular Gives The Facts

For complete technical data on both rising stem and non-rising stem patterns . . . size listing, etc., get Circular AD-2340 from your Crane Representative, or by writing to address below.

CRANE VALVES & FITTINGS

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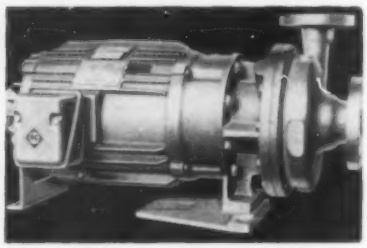
relay. A selector switch checks stations in order, 12 per minute. Signals from thermocouples or other sources are indicated continuously or by moving pointer of the meter-relay. The alarm is sounded if the indicating pointer touches a limit pointer. It is noted that since only one meter-relay is used, the scanner is generally more economical than many controls for accomplishing essentially this purpose. Assembly Products, Inc.

9—TINY SERVICE GAGE for pressure, vacuum indications

Model P-1 Miniature Service Gage is described as a precision gage at modest cost. A round, vertical unit, portable and hand operated for measuring pressure, vacuum or differential readings, it is available in ranges of 0 to 3 in. mercury and water, 0 to 40 in. of water using mercury, and 0 to 24 oz using mercury. The entire gage can be disassembled for cleaning. Details on it are in Bulletin 217. Ellison Draft Gage Co., Inc.

10—SINGLE-STAGE PUMP in capacities to 500 gpm

Designed for handling costly or volatile substances at temperatures to 200 F, this Electri-Cand Pump is a single-stage, single-suction pump announced for leakless handling of all liquids. It is



available in capacities to 500 gpm, at heads to 250 ft. Pumps in the ¾- to 1½-hp range are constructed on a fractional motor frame while units from 2 to 15 hp are on an integral motor frame. This pump requires neither mechanical seal nor packing. Carbon sleeve bearings, impervious to many chemical and corrosive agents, are used in the motor. Pump and motor are a single integrated unit. Allis-Chalmers Mfg. Co.

11—ILLUMINATED INDICATOR measures, transmits, receives

Pressure, draft, differential, and level are directly measured, indicated, and transmitted by the Multi-Pointer Gage Unit. It is also furnished as a pneumatic receiver. As a direct-connected gage, each indicator section may contain a diaphragm element for draft, low pressure, or differential measurement; a bellows element for intermediate pressure or level measurement; or a bourdon tube for high pressure measurement. Standard ranges from 0–0.5 in. H_2O to 0–5000 psig are available.

As an indicating receiver each gage unit may contain two pneumatic receiving bellows. The gage unit then indicates any two variables capable of being transmitted pneumatically over standard SAMA signal ranges of 3–15 or 3–27 psig. As an indicating transmitter, one section of unit is occupied by the measuring element; the second section contains a pneumatic or an electric transmitter. Any number of gage units may be mounted adjacent on the same panel. Seven-in. indicating scales come in five colors and white. Bailey Meter Co.

12—RATIO REGULATOR, self contained, proportions and blends

Described as a fundamentally different type of liquid ratio regulator, the Type R is designed to automatically proportion and blend a secondary stream to the measured flow of an uncontrolled primary stream, despite line pressure variations. Flow measurement, ratio control and actual blending are accomplished within a single, self-contained regulator having only two moving parts, operating with minimum pressure difference of 5 psi, and requiring no outside source of power and no straight runs of approach or discharge piping. Only adjustment is a calibrated ratio setting dial. Accuracy is reported to be maintained throughout a 5 to 1 ratio range, 2 to 1 primary flow range. The W. A. Kates Co.

13—VERTICAL MOTOR for all weather conditions

For outdoor operation under all weather conditions, this vertical motor is announced as meeting NEMA Type II weather protected specifications and comes in ratings from 250 to 2000 hp, in both hollow and solid shaft construction. Primary uses for ...e in chemical and petroleum processing, and other applications in which vertical motors must operate without shelter or additional protection. The motor is cooled by ventilating air taken from the surrounding atmosphere. To free this air of moisture and dirt before it enters the heart of the motor, it goes through three 90-deg changes in direction, is lifted vertically through screens, and expands in an air passage so that velocity is reduced to less than 600 fpm. The motor's bearing construction, as standard, provides high thrust capacity. Bulletin 2600 gives engineering data. The Louis Allis Co.

14—LUBRICANT prevents galling of threads

Ferulube is announced as an excellent lubricant for reducing wrench torque in the make-up of bite type tube fittings such as Ferulok. This torque is high, particularly when making up fittings on large size stainless steel tubing. Tests are reported to show that use of Ferulube on the ferrules and threads of the fittings can reduce make-up torque as much as 75 per cent. Parker Fittings & Hose Div., Parker-Hannifin Corp.

15—DEAD-END CLAMP for wide range of cables

For primary and secondary deadening, the CUW-R type clamp combines snub action of a deep cable groove pocket with wedge action of a V-groove for maximum holding strength on each cable size. Four clamps cover range from No. 4 through 636 ACSR and No. 2 through 715.5 all aluminum. Additional features announced include a saddle with captured U-bolts to prevent incorrect assembly of saddle, lifting eye and side pulling eye standard on all sizes, humpback cotter pin and headed clevis pin for easier "hot" line work, long U-bolts enabling cable to be threaded into clamp without removal of the clamp. Burndy Corp.

16—GENERATOR for use with gasoline or diesel engines

This "packaged power" generator features a static excitation and voltage regulation system which contributes to almost maintenance-free operation, according to manufacturer. The system has no moving parts, tubes, vibrating contacts or commutator brushes. The exciter consists of several rectifiers, a saturable reactor, resistors and wiring, all mounted in a dripproof enclosure. It is noted that since the exciter contains a minimum number of parts, none of which moves, it is virtually free from variations in service. The generator has many applications as a stand-by electrical power source. It is available in 60-cycle ratings from 219 through 375 kva at 1800 rpm and 187½ through 250 kva at 1200 rpm. It is reported suitable for operation at 10 per cent overload for 2 hr. Manufacturer says the high motor starting ability will meet almost all starting requirements. General Electric Co.

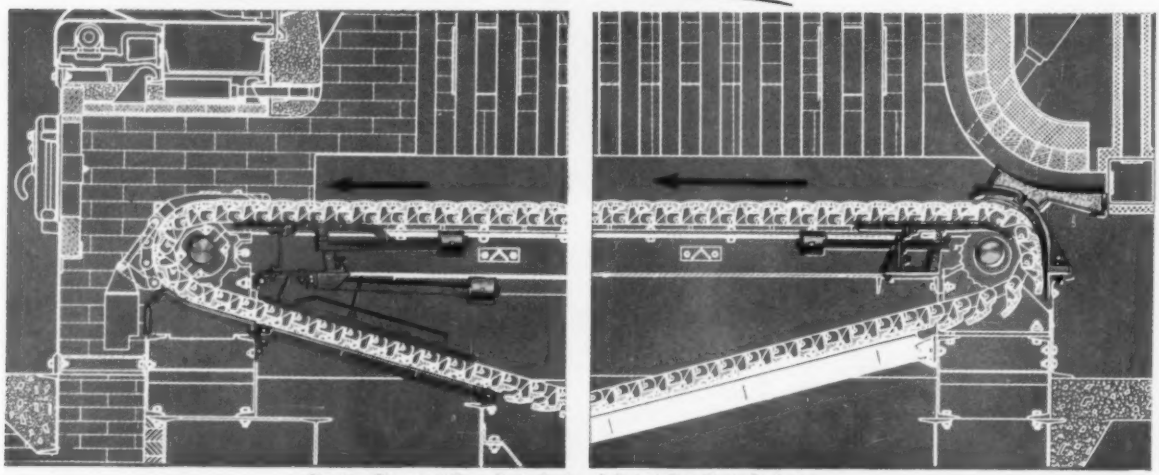
17—SPEED REDUCERS, single or double reduction units

These shaft-mounted units are available as single reduction drives in six sizes with nominal ratios of 5 to 1 and capacities to 50 hp; and as double reduction drives in seven sizes, ratios of 15 to 1, capacities to 40 hp. They can be mounted at angular as well as horizontal positions by tie rod or foot mountings. Lubrication is by means of live-action oil spray generated automatically through gear rotation. The units are furnished with key for hollow shaft sizes and with bushings, complete with key for driven keyseat to adapt hollow shaft bore to smaller driven shaft sizes. All are available "off the shelf." Book 2618 gives data. Link-Belt Co.

18—WATER LEVEL GAGES improved for easier reading

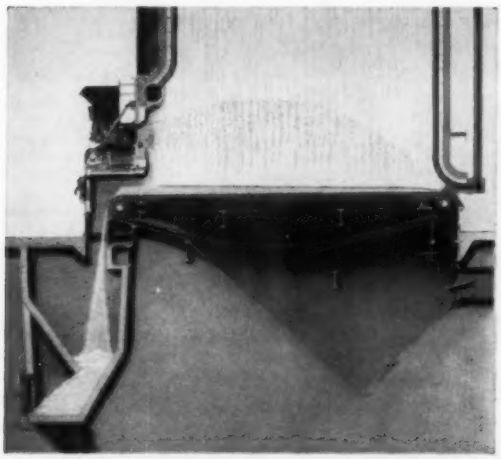
Remote reading water level gages in this company's Eye-Hye line have been redesigned, in higher pressure models, for wider vision. The image of the distinctive green indicating fluid, Vizzene, is carried out in front of the face plate by a protruding plastic reading medium to

DOWN WITH EXCESS AIR!



Floating Front and Rear Grate Seals—A Detroit RotoGrate Exclusive.
They decrease excess air.

Automatic Air Seals Exclusive With Detroit RotoGrate Stokers Reduce Excess Air to 22% and Lower



Detroit RotoGrate Stoker — an advanced design spreader stoker with forward moving grates, for medium and large boilers. Burns all ranks of bituminous coals and lignites without special preparation . . . also many waste or refuse fuels, either alone or in combination with coal. Efficiency is high — maintenance low.

Many users reduce excess air to 22% or under, due to these free floating automatic front and rear seals with adjustable counterweights. They really seal, and stay sealed even after years of service. Air is directed to the active combustion zone. The result is increased combustion efficiency and economy.

The rear under-grate seal plate provides a quiet coking section which extends across the furnace . . . expedites the ignition of green fuel.

These and many other exclusive features of advanced design make Detroit Stokers your best buy. There is a type and size Detroit Stoker for any boiler capacity from 3,000 to 400,000 pounds steam per hour.

DETROIT STOKERS COST LESS: COST = INITIAL INVESTMENT + UPKEEP + PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • • MONROE, MICHIGAN

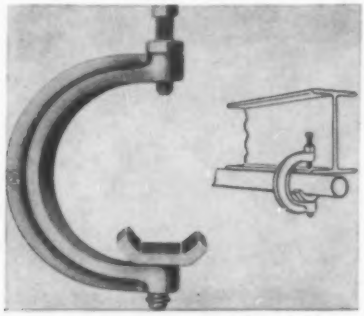
District Offices or Representatives in Principal Cities

For more data circle 542 on Post Card

enable boiler room attendants to read the water level at any angle, even 90 deg from center, either side. Manufacturer points out that while the simple manometer principle of the gage operation remains unchanged, construction is improved, including a high power illuminator. Models for pressure to 900, and to 1500 and 3000 psi are described in Catalog sections C3.1B and C4.1D. The Reliance Gauge Column Co.

19—IRON CLAMP for pipe under structural steel

The G-clamp is described as a C-clamp with the proper size pipe or conduit saddle added to its lower jaw. This malleable iron clamp is intended for use where conduit and pipe up to 4-in. size need to be supported directly under structural



steel. Maximum recommended loads are from 210 to 450 lb for the smallest to the largest sizes, and maximum temperature is 450 F with a safety factor of 5. The saddle swivels to permit suspension of pipe or conduit at any angle in a plane parallel to the face of the supporting flange. Where suspension of pipe or conduit from steel beam to steel beam is satisfactory for the service required, the G-clamp is said to provide simplified support without need for a beam clamp, rod and pipe clamp. Suggested uses include fire protection piping, cold process piping or plumbing and support of electrical conduit. Manufacturer does not recommend this clamp for applications where the piping is used to carry hot fluids such as steam or hot water. Grinnell Co., Inc.

20—RECORDER-CONTROLLER, null-balance, strip chart

Continuous standardization and unitized construction are features of this null-balance strip chart recorder-controller. It is available in a d-c potentiometer, a-c or d-c bridge version, and both single-pen and multi-record types. Calibrated chart width is 10¾ in. The instrument can be used to measure and record watts, vars, power factor and frequency. Other applications include measurement and recording of pH, conductivity, temperature, flow and pressure. Continuous automatic standardization is achieved by means of simple, silicon (Zener) diode reference. All major components of the instrument are mounted on the rear of the mechanism panel which swings out through a 160-deg arc. Mechanism design allows use of up to four switches and four transmitting slidewires. Use of a universal standardized slidewire reduces range change to replacement of a range card, manufacture points out. General Electric Co.

21—BONNET VALVES for use with gages, instruments

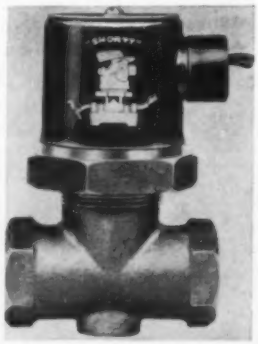
This improved type of outside screw and yoke bolted bonnet valve is offered for use with liquid level gages and instruments. The bonnet uses a forged yoke which supports the stem away from valve body and separate gland-follower which bears directly on the packing and is independent of yoke. This construction places threaded portion of the stem outside of valve body where it is not affected by temperature or nature of liquid being handled, company notes, and this design lets the valve stem work freely at all times and prevents freezing. Valves are available for all pressures, in offset, double union and jacketed styles. Inlet connections are spherical union, flanged, socket welding, solid shank and union. Ferguson Gage & Valve Co.

22—VACUUM PUMP features design improvement

Arrangement of this two-stage vacuum pump, shorter and more simple in construction than previous model, provides equipment that is more easily serviced. The motor has been moved from the middle of the set-up and placed at the end, permitting use of a standard single-shafted motor of open or closed design. A totally enclosed motor can be employed in outdoor locations or harsh atmospheres, company says, or an open motor. Simplified piping for interstage connection is more compact. Eliminated are parts previously considered essential, such as moisture separator on the interstages and the interstage water alarm. Allis-Chalmers Mfg. Co.

23—SOLENOID VALVE is compact in size, low in price

An all-purpose two-way solenoid valve, the Shorty is compact in size, as its name implies — 4¾ in. high by 3 in. wide with height from top to line only 3-13/16 in. Of cast bronze, Shorty is low



priced and its applications include air and gases to 250 psi, water to 150, oil to 75 psi and steam to 25 psi. Pilot-operated, the valve can be kept open with a pressure differential as low as 5 psi. Features announced include stainless steel pilot, unbreakable stick-free piston rings, and replaceable resilient seats. Bulletin KK 160 gives data. Atkomatic Valve Co., Inc.

24—TEMPERATURE SENSOR for large rotating machinery

Model S-3 features a non-inductive bifilar-wound resistance element which is also insensitive to strain gage effect. Three high-temperature insulated leads are provided for bridge circuit connections independent of lead wire resistance. Encased in epoxy-glass laminate, sensor is described as exceptionally rugged, able to operate in temperature ambients of −55 to 150 C for unlimited time. Sensor resistance element is standard 10-ohm, plus or minus 0.02 ohms at 25 C, with a change in resistance of 0.00385 ohms per ohm per degree C. Measuring 0.078 in. in thickness, sensor is available in various widths and lengths. Minco Products, Inc.

25—CABLE CLAMP secures armored cable in ladder supports

This cable clamp, designed to secure armored cable in ladder cable supports, comes in both galvanized steel and aluminum, and fits cable from ¾ in. up to 8½ in. diam. The clamp may also be used to secure several small cables together. Rungs of company's cable ladder are slotted to receive the cable clamp; it is secured by a bolt. The clamps also serve to keep cables segregated. T. J. Cope Div., Rome Cable Corp.

26—AUTOMATIC WRENCH works on all types of nuts

Just a "flick of the wrist" is all that is required to tighten or loosen the Flikit Instant Grip Automatic Wrench. You simply place wrench on nut and turn

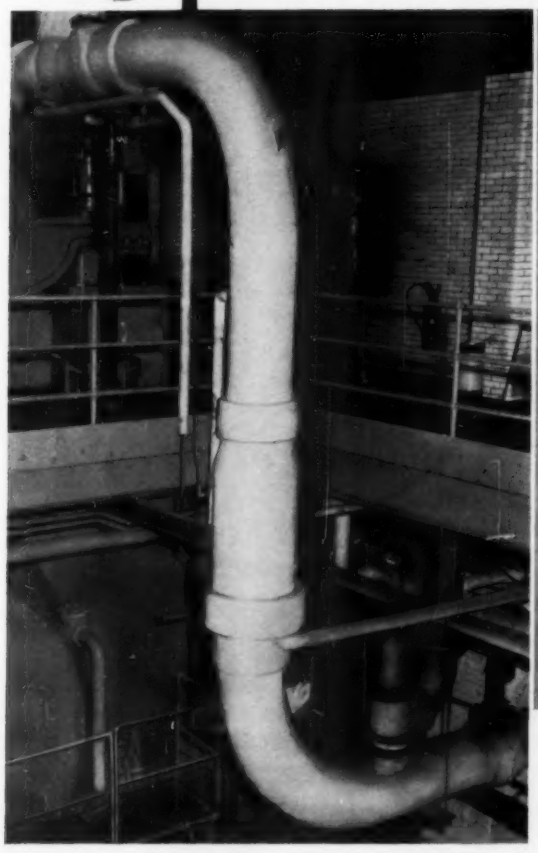
handle to tighten or loosen; the jaws close automatically on whatever size nut you are tightening. Flikit Wrenches come in three sizes and each size handles all types of nuts — square or hex. The Custanite Corp.

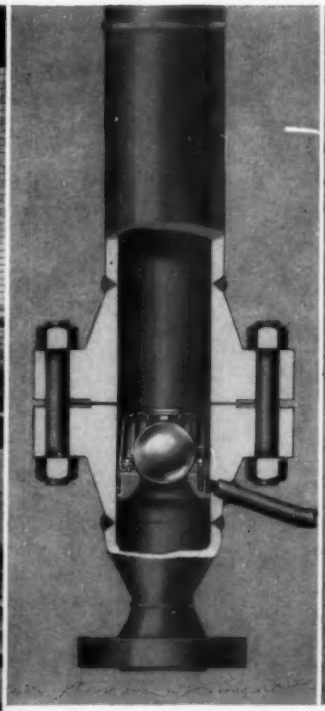
27—ELECTRONIC CONTROLS offer operational advantages

Electronic Consotrol Instrumentation, a series of solid state electronic control instruments, consists of transmitters, recorders, controllers, and valve operators, covering every function in the process control loop. Typical process measurements — pressure, flow and level — are converted at the transmitters to proportional current signals and transmitted over unshielded lines to a control center. Converters for EMF and resistance measurements also feed signals to the small case, panel-mounted receivers. In the same electrical range are the controllers and final operators which complete the loop.

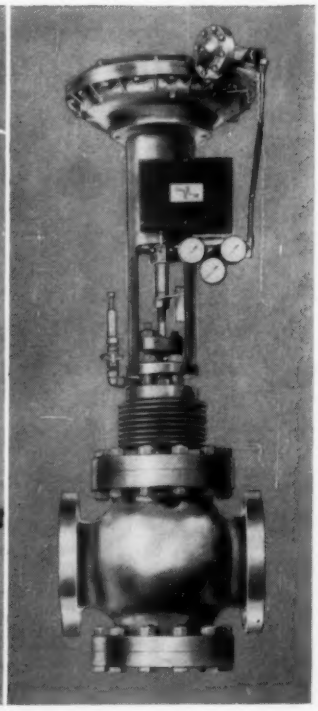
Outstanding features of the instrumentation, in addition to use of magnetic amplifiers and transistors, are: choice of motion balance or force balance transmitters; electrical measurement converters, tubeless and mounted for front-of-panel accessibility; diversified installation arrangements using standard system components. Another

How Copes-Vulcan control systems boost power plant efficiency





Steel ball controls orifice opening. Incoming steam lifts the ball in an amount determined by the weight of the ball and the amount of steam flow. Pressure drop of about 3 psig is held constant at all rates of flow.



Copes-Vulcan valve . . . for regulating desuperheater cooling water. Noted for accuracy and dependability, Type CV-D diaphragm-operated valve is available in sizes to 12-inch. Write for Bulletin 1027.

New Copes-Vulcan Desuperheater handles the tough temperature control jobs

Using a unique design principle Copes-Vulcan's newly developed Variable-Orifice Desuperheater* provides superior temperature control demanded on the most critical job. Installed in a steam header supplying a 12,500-kw turbine-generator, this desuperheater holds temperatures within a plus-or-minus 3F limit—even though it is located just 20 feet upstream of the turbine throttle.

With only one outside connection and only one moving part, the Variable-Orifice Desuperheater simplifies maintenance. Skillful design eliminates the need for long runs of piping, atomizing steam, spray nozzle and glands.

The Variable-Orifice Desuperheater is one of several types—each engineered to meet particular operating requirements. Write for Bulletin 1037.

Single source . . . custom design . . . skilled service

Desuperheaters are a part of Copes-Vulcan's complete line of control systems for superheat and reheat temperatures, feed water, combustion and pressure reducing operations.

Available in separate units or integrated into a single package, these control systems are custom-designed to meet individual specifications, and are serviced periodically by experienced Copes-Vulcan field engineers. For a survey of the line, write for Bulletin 1022-B.

*Patent applied for.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

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Underground hot pipes stay free from trouble...when you INSULATE WITH GILSULATE

One of the most difficult problems in designing underground hot piping systems is providing positive corrosion protection against electrolytic, chemical or galvanic attack. The answer lies in the use of GILSULATE. For, in addition to its excellent insulating properties, this naturally-occurring hydrocarbon is chemically neutral in all soils, dielectric, and moisture-proof and water-proof as well.

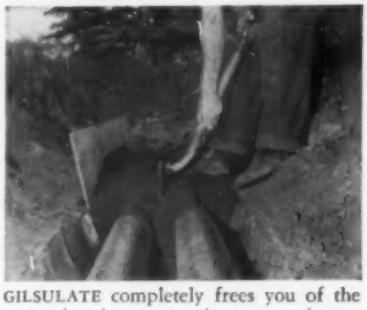
GILSULATE's low thermal conductivity, low cost and easy installation make it possible for schools, colleges, housing projects, hospitals, industrial plants and other institutions to install central heating with underground piping and to realize the savings in equipment and operating costs which such systems provide.

We'll help you with your plans

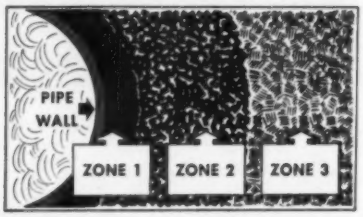
If you are planning to rehabilitate present piping, or to install a new underground hot piping system, call the nearest GILSULATE Distributor listed on the page opposite this advertisement. His own extensive experience in heating and air conditioning, plus the research, engineering and field supervision facilities of the American Gilsonite Company are at your disposal...without obligation. They will work with your engineers in checking specifications, unusual soil conditions, and actual installation to make sure that the finished job is completely satisfactory.

If you would like complete information on GILSULATE insulation, or would like to be put on the mailing list to regularly receive free copies of PIPE INSULATION NEWS, send your request to any of our offices.

GILSULATE IS EASY AND ECONOMICAL TO USE



GILSULATE completely frees you of the expensive, time-consuming preparation required by many insulating systems. You just pour it into the pipe trench, shovel-point it around the pipes, and tamp it. Pipe heat does the rest.



Heat fuses the GILSULATE to pipes and joints to form three zones: Zone 1, a flexible, heavy-duty water barrier; Zone 2, of firmly-cemented granular GILSULATE that provides excellent thermal insulation under wet or dry conditions; and Zone 3, which provides a final zone of thermal insulation and a support for the water-proof structure.

GILSULATE®
TRIPLE ZONE INSULATION
FOR UNDERGROUND HOT PIPES

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GILSULATE's unique properties

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Holly Specialties Co., Inc.,
Walnut & 63rd Streets, Philadelphia 39
J. F. Scouler Company, 2120 Market St., Camp Hill
Tutein Equipment Co., P. O. Box 4453, Pittsburgh 5
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John M. Dooley & Assoc., 1832 McCalla Ave., Knoxville
Hurston-Conaway, Inc., 2470 Poplar Avenue, Memphis
TEXAS
J. R. Dowdell & Co., Austin, Corpus Christi, Dallas,
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Perry Products Ltd.,
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Michael Stuart Co., Ltd.,
102 Eglinton Ave. E., Toronto, Ontario

advantage stressed is d-c transmission so that unshielded leads can be used with no effect from a-c pickup, and current system unaffected by changes in line or load resistance induced by ambient temperature. The Foxboro Co.

Reader Service Cards on pages 105–106 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

28—HAND TACHOMETER is accurate, easily read

Dial diameter of the Jagabi Precision Hand Tachometer is 4.7 in. (120 mm) and the scale calibration is conveniently open and easily readable, it is pointed out. This single-range tachometer is suggested for accurate speed measurements in laboratories, test beds and similar applications. According to manufacturer, the sturdy construction of this instrument contributes to low maintenance and dependability. The tachometer is supplied with two large rubber mounted male and female centers, an extensive shaft and center, oil container and dropper and comes in a strong case. Total weight is 3¼ lb. Bulletin 35–24 gives details. James G. Biddle Co.

29—SAMPLE COOLER for constant boiler water analysis

Constant analysis of boiler water or other heated liquid characteristics is the function of this compact sample cooler. Its overall height is 7⅝ in. and outside diameter measures 4½ in. Body and cap

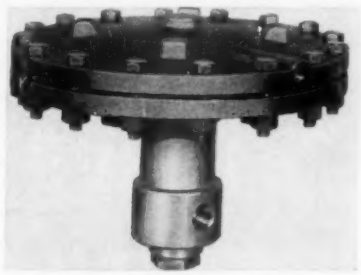
are ¼-in. cast bronze and house a 12-ft cooling coil of ¼-in. copper tubing through which the hot sample flows. Sample inlet and outlet are each ⅜-in. diam. The coolant is introduced through a ½-in. inlet, passes over the copper tubing and leaves via a ½-in. outlet. The Bird-Archer Co.

30—VARIABLE FLOW INDICATOR with adjustable range

Akron Flow Indicators show at a glance whether flow is taking place. Claimed clearly visible from a distance, even in a bad light, a chromium plated ring spinning under a glass dome has movement which precludes chance of misreading. It is reported useful wherever there is circulating water or oil. Specific applications include cooling water to air compressors, condensers, oil coolers; lubricating oil to bearings, gear trains; cooling oil to transformers etc. Variable flow models can be reset in the field for high or low range and have die-cast brass body in ½- to 1-in. pipe sizes for flows from 0.72 to 24 gpm. Other models are available for flows from 0.075 to 120 gpm in pipe sizes to 3 in. McIntosh Equipment Corp.

31—REDUCING VALVE for air, gas or hydraulic operation

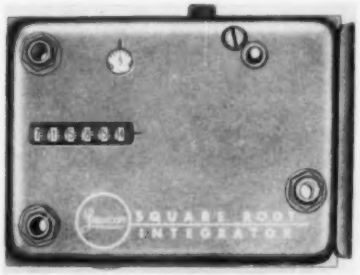
Type E, Fig. 198 is a high pressure reducing valve designed for handling large ratio pressure reductions from 6000 psi initial pressure to outlet pressures from 100 psi upward to within 20 per cent of



initial pressure in one stage. The valve is adapted for air, gas or hydraulic operation. Instead of a spring it employs a small air reducing and relief valve for charging a diaphragm chamber as a means of controlling the reduced pressure. This provides an easy adjustment that can be made from a remote point, company points out. Trim is stainless steel with spindle and seat ring Stellited and wearing surfaces chromium plated. Where hydrogen or other gases are to be handled, Nylon seats are available. Atlas Valve Co.

32—SQUARE-ROOT INTEGRATOR automatically totals flow

Model 26 Square-Root Integrator, designed to provide a continuous means of automatically totaling flow, is intended for use in standard flowmeters utilizing the output of conventional sensing elements. It has broad application, including that of pressure correctors on positive displacement meters. It can be



adapted to miniature strip chart flow recorders, forming an electro-mechanical integrator.

The compact integrator utilizes a double disc and ball integrating mechanism. With a given speed on the lower disc, the upper disc and counter turn at a

flying saucers!

Two reliable, packaged Cleaver-Brooks boilers maintain high-speed production of Texas-ware and Dallas-ware melamine dishes for Plastics Mfg. Co., *Dallas*

Chief engineer, W. L. Cone, Jr., states: *"Consistently dependable steam supply is keynote of our plant operation. That's why we chose two Cleaver-Brooks gas-fired boilers for our steam source.*

"One feature we appreciate about these new boilers is the easy access to their internals. Not only does this facilitate frequent inspections but also it greatly reduced their cost. There are no joints that require re-sealing every time the boiler is opened. Being hinged and davited, the doors and heads do not have to be hoisted for removal. Six bolts can be removed in less than two minutes."

Guided by experience

"Based on nine years of unfailing performance delivered by two 50-hp Cleaver-Brooks boilers we used in our former plant, there never was any question that we would install their equipment in our new plant," said Mr. Cone.

Architects for the new plant were: Thomas, Jameson and Merrill; Consulting engineers: Zumwalt and Vinther; General contractor: Carpenter Bros.; Mechanical contractor: Beard Plumbing Company, all of Dallas.

"Our 125-hp, 250-psi design pressure, gas-fired Cleaver-Brooks boilers provide all steam for compression-molding presses, office space heating and hot water heating" — W. L. Cone, chief engineer.

Cleaver-Brooks packaged boilers are America's largest selling packaged boilers. Available in 19 sizes, 15-600 hp, 15-250 psi. Oil, gas or combination oil/gas fired. For complete information contact nearest representative or write: Cleaver-Brooks Co., Dept. M, 311 E. Keefe Ave., Milwaukee 12, Wisconsin, U. S. A.

Originators and largest producer of packaged boilers

Cleaver Brooks®

"See you at the Power Show — December 1–5, 1958 Coliseum, New York, N. Y."

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speed proportional to the square roots of the displacement of the balls from the center of the disc. Linearity of the square-root integrator is 0.25 per cent of full scale, achieved with a repeatability of 0.05 per cent of full scale. Maximum recommended input speed of 60 rpm, combined with a full scale ratio between time shaft and counter of 2:1, provides the counter with a maximum rate of 300 counts per minute. The unit has an unput shaft torque of 0.35 in.-oz maximum and a shaft rotation of 18 deg, 30 min. Librascope, Inc.

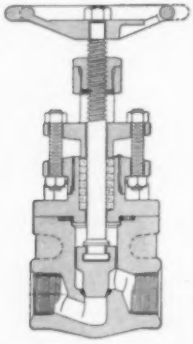
33—HEX WRENCH with adjustable four-sided jaw

An adjustable four-sided jaw that's easy to put on or take off, is a feature of this improved hex wrench. Its angular jaw design is said to give more leverage and a positive grip on hex nuts, square nuts,

valve packing nuts, unions and gas cocks, rough or finished. Narrow jaws facilitate operation in tight places. Of heavy-duty construction, tool has comfort-grip I-beam handle. Wrenches are available in three sizes, No. 11 for ¾ to ¾ in., No. 17 for ⅝ to 1¼ in. and No. 25 for 1 to 2 in. nuts. The Ridge Tool Co.

34—GLOBE VALVE for general purpose use

This round bolted bonnet, bolted gland globe valve is for 150 to 800 lb service and is available with screw ends or socket weld ends in ¼-through 2-in.



sizes. These valves have forged steel bodies with integral seats hard faced with Stellite or equal. Disks are 13 per cent chrome stainless steel. Other trims are available. Henry Vogt Machine Co.

35—REGULATOR controls current to a-c motors

For measuring and controlling current to a-c motors and circuits, this company's Motor Load Regulator now

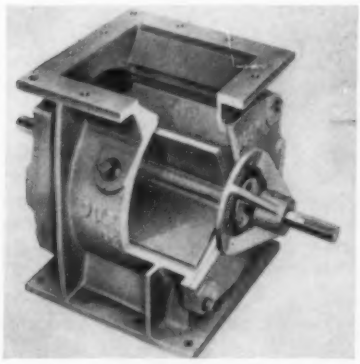
comes with a selection of specially sized cams for automatic set point adjustment. The electro-pneumatic controller can be adapted for current measurement and transmission or automatic control with reset action. By measuring and converting current flow to a pneumatic signal, advantages of pneumatic instrumentation are retained. Applications include motor driven compressors, blowers, and others in which motor drives range from 5 to 10,000 hp.

As a controller, set point is established locally by manual adjustment or remotely by automatic pneumatic adjustment. Any variation in set point (or pressure signal from a master controller) causes the motor load regulator to increase or decrease process load on motor. In such control applications where automatic set point adjustment is employed, the cam in the set point can be matched to process characteristics.

When used for current measurement, the pneumatic output is a 0–30 psi signal. A typical current limiting application is protection of high powered motors against process surge overloads. The instrument is a nominal 5 amp device with application characteristics similar to overcurrent relays. Accuracy is given as ±0.1 amp and repeatability better than 0.05 amp. Hagan Chemicals & Controls, Inc.

36—ROTARY AIR LOCK offers design advantages

Type G Rotary Discharge Gate, for dust collection, pneumatic conveying and feeding applications, features a ruggedly constructed housing with square flanged inlet and outlet, outboard removable bearings and a pressure equalizing tap for applications involving a high pressure differential. The outboard design



protects the bearing from damage by hot or sticky materials, and also serves to prevent bearing lubricant from contaminating material being handled. The packing gland is accessible from the outside.

There are four styles: Style 4 (shown) has a four-blade open-end rotor and is suggested for general low pressure discharge applications, such as on cyclones and filters. Style 6 has a six-blade, open end rotor and is for low pressure pneumatic conveying systems. Style 6C, with a six-blade closed end rotor is for pressure pneumatic conveying systems. Style SP, with either four or six "shallow pocket" blades is for handling materials which tend to stick or build up. The housing is constructed so that all rotors are interchangeable; it can be supplied in cast iron or cast aluminum or wrought stainless steel. The Ducon Co, Inc.

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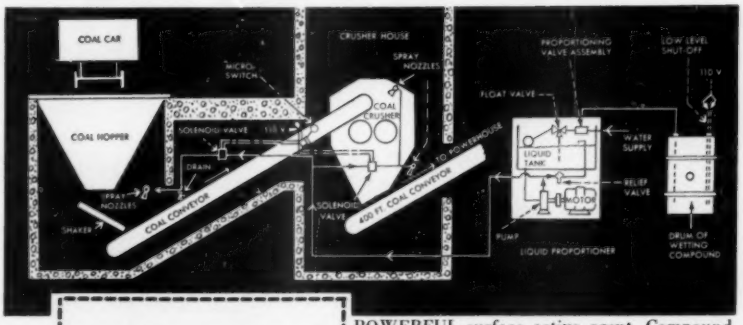

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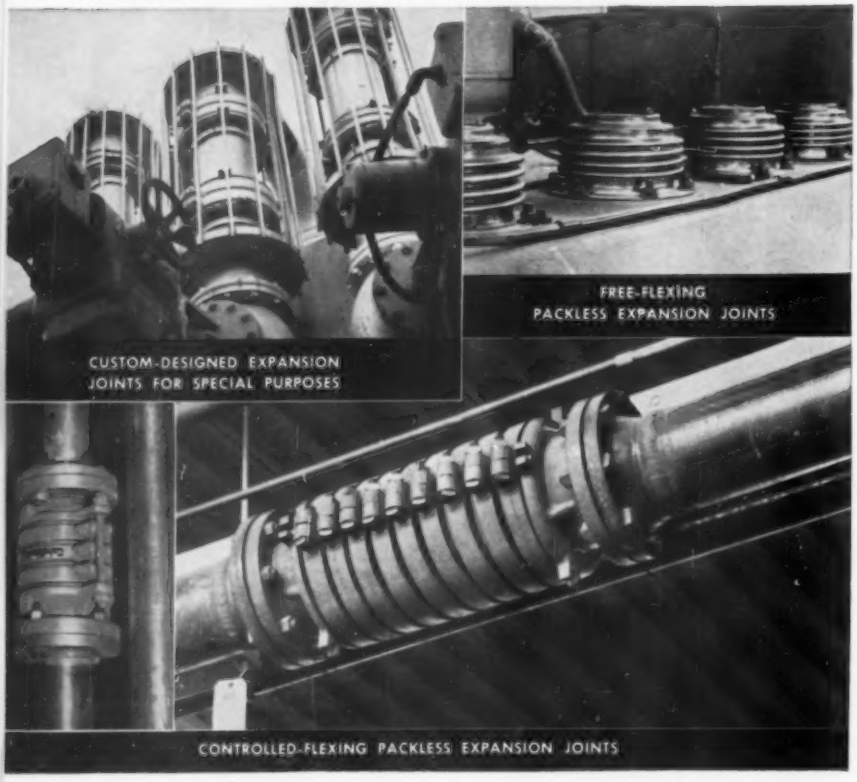

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NEW ENGINEERING BOOKS

How to Become a Professional Engineer, by John Constance. 272 pages, 5½ by 8 in., 16 chapters. Published by McGraw-Hill Book Co, 327 W 41st street, New York 36, N. Y. Price $5.50.

An invaluable aid in preparing for registration examinations, this book explains how to prepare an application; gives pointers on selecting the applicant's qualifying experience and writing it up; shows how to prepare for written and oral examinations and how to avoid emotional stress during tests.

As a mechanical engineer with M. W. Kellogg Co, Constance is also known to our readers as an author of several articles in POWER ENGINEERING HANDBOOK (see issues for Apr, May, June, July, Aug and Sept, 1957).

Of equal benefit to both unlicensed-engineers-in-practice and young graduates, the book presents all the facts you have to know about becoming licensed in your home state and in achieving multiple-state registration. Names and addresses of state board secretaries, accredited schools and recommended texts are listed. For those considering a refresher course, Mr. Constance details things to look for and warns of pitfalls in some courses.

★ ★ ★

Metal Grating Handbook. Size 8½ by 11 in., paper cover, 32 pages. Published by Metal Grating Institute, Inc, One Gateway Center, Pittsburgh 22, Penna. Price $1.

Presented as the first all-inclusive technical publication to represent standardization in the metal grating industry, this booklet contains drawings, tables, and actual installation photographs, as well as complete standards and specifications. It also contains a glossary of terms and definitions.

★ ★ ★

Fundamentals of Thermodynamics, by Carroll M. Leonard, 1958, 376 pages, 6 by 9 in., cloth. Published by Prentice-Hall, Inc, 70 Fifth Avenue, New York 11, N. Y. Price $8.00.

First three chapters present the basic laws of thermodynamics, while the rest of the book is given over to gas and gas-vapor mixtures, flow of gases and vapors, and to heat transfer. The author includes a new and unusual multi-colored Mollier chart with the latest information on high pressure and high temperature ranges of steam. The New Interim Steam Tables prepared by ASME are also part of this book, as are the Gas Tables in abridged form.

Leonard uses many examples, which are presented in detail. Engineers confronted with design problems in connection with power plants, refrigeration systems, equipment for air-conditioning plants, or com-

pressor stations will welcome the book's flexible organization and easy-to-find help for job problems.

The author is professor of mechanical engineering at Oklahoma State University. With Vladimir L. Maleev he was author of the well-known work, Heat Power Fundamentals (1956).

★ ★ ★

Symposium on Basic Effects of Environment on the Strength, Scaling, and Embrittlement of Metals at High Temperatures, ASTM Special Technical Publication No. 171. 120 pages, heavy paper cover, size 6 by 9 on. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $2.75.

★ ★ ★

ASTM Standards on Light Metals and Alloys, Cast and Wrought. 276 pages, heavy paper cover, size 6 by 9 in. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $3.50.

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Symposium on Industrial Water and Industrial Waste Water. ASTM Special Technical Publication No. 207. 52 pages, 6 by 9 in., case bound. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Penna., 1957. Price $2 (to members, $1.50).

Disposal of industrial water has become increasingly important. Stream pollution and reuse of water by other industries has made control of waste products a major concern of water chemsts and engineers. This symposium covers several aspects of the problem. It was presented at the Second Pacific Area National Meeting, held in Los Angeles under the auspices of ASTM Committee D-19 on Industrial Water.

★ ★ ★

Manual on Industrial Water. American Society for Testing Materials, Special Technical Publication No. 148-B, Third Printing, 1956. 502 pages, 6 by 9¼-in., cloth. Published by ASTM, 1916 Race St, Philadelphia 3, Penna. Price $6.00.

★ ★ ★

Safety in Welding and Cutting, an American Standard prepared by ASA Sectional Committee Z49 under sponsorship of the American Welding Society. 49 pages, 6 by 9 in., paper bound. Published by American Welding Society, 33 W 39th St, New York 18, N. Y., 1958. Price $2.

This is a complete revision of the AWS-ASA Z49 standard, and covers the entire field in great detail. Protection of personnel is discussed thoroughly and includes precautions necessary when using the newer welding processes. Recommendations are made for adequate shielding from flying particles and harmful rays. Health protection and ventilation, fire prevention and protection, safe handling of fuel gas and oxygen cylinders — all come in for intensive study and recommendations.

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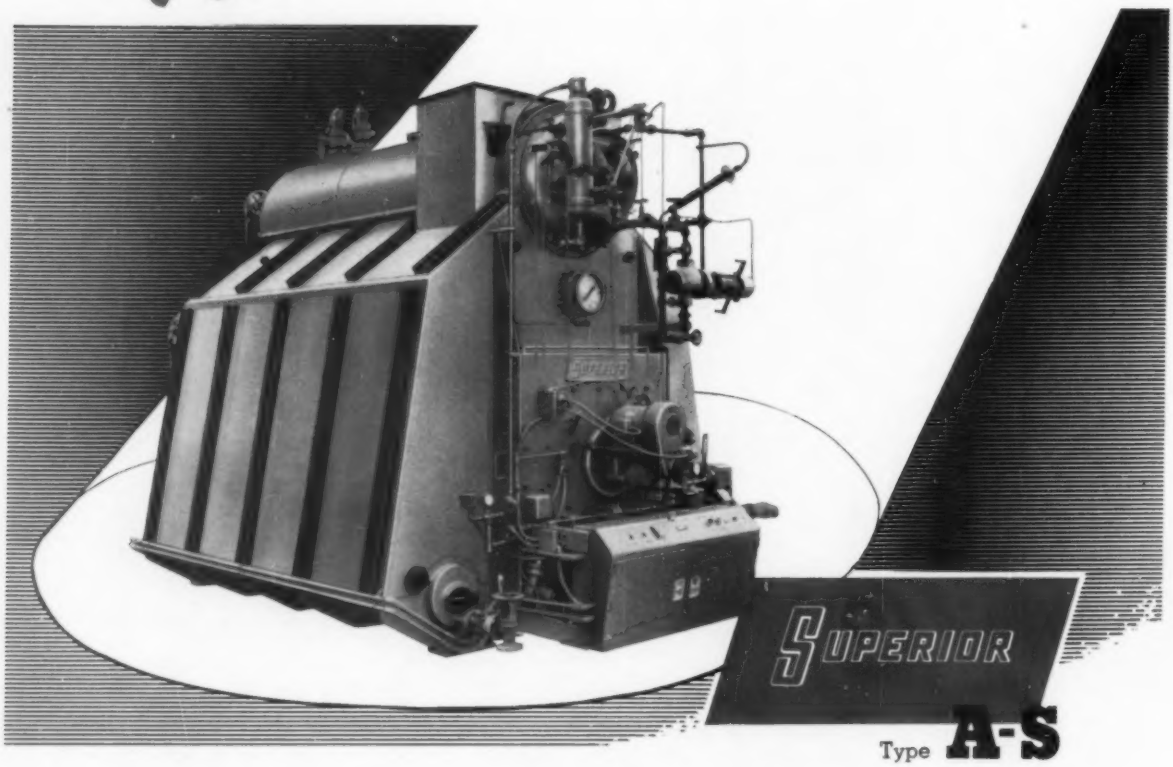

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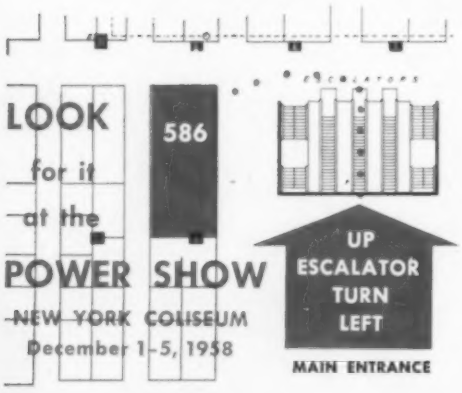

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202 Temperature Regulators — Six-pp Bulletin 1012 describes company's line of steam regulating valves with pilots for both fast and slow heating exchangers. Selection tables and line drawings of typical applications are also included. Spence Engineering Co., Inc.

203 Guide to Gages — Catalog 300-B, 112 pp, features Ashcroft Duragauges, Maxisafe, pneumatic receiver, recording, quality, drawn case, chemical and special application gages. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in., pressures from 30 in. vacuum or a few ounces up to 100,000 psi. Manning, Maxwell & Moore, Inc.

204 Bi-Color Gage — Bulletin 1174 describes advantages of company's multiport bi-color gage made for medium and high pressure ranges. A cutaway view illustrating component features is included, as well as drawings and photos. Diamond Power Specialty Corp.

205 Metering, Control Systems — Bulletin 500 describes purpose, design and operation of company's metering and control systems. Includes discussion of pneumatic and electric telemetering and pneumatic control, along with detailed literature references. Bailey Meter Co.

206 Station Controls — Described in 12-pp Bulletin 1032 are the control systems which help make more power for an outdoor Carolina steam-electric generating station. Text is illustrated with photos, schematic and block diagrams. Copes-Vulcan Div., Blaw-Knox Co.

207 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

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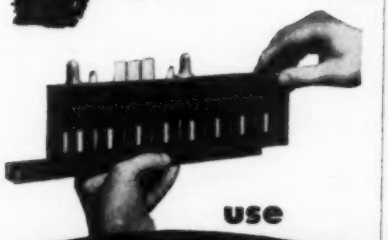

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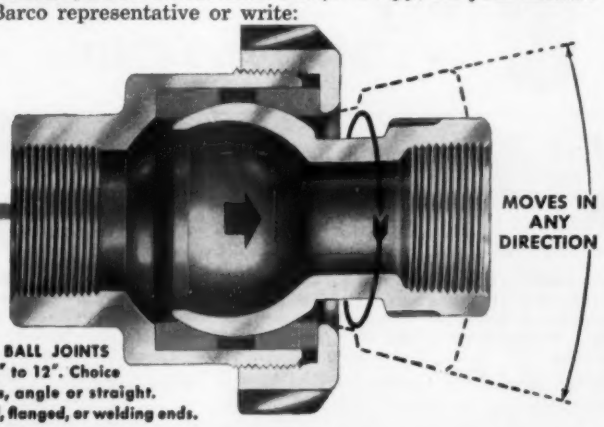

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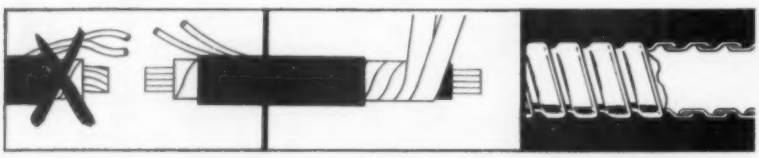

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on how to get safe, dependable, trouble-free electrical protection. Shows what to do when fuses blow, how to determine cause of blows, what kind of fuse to use for various circuits. Contains short history of fuses and notes on construction of fuses. Bussman Mfg. Div., McGraw-Edison Co.

209 Cable Troughs — This 28-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and many special fastening devices to save time and labor. Contains full instructions for installations, load charts, accessory items. The Globe Co.

210 Electrical Enclosures — Bulletin EE, 14 pp, describes company's line of sheet metal electrical enclosures and other related items for a variety of applications. Covers control desks, electrical cabinets and enclosures, power distribution and control panels, boiler, turbine generator control panels, switchgear housings, and others. The Kirk & Blum Mfg. Co.

211 Testing Instruments — Bulletin 19-58, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, covering chief features. James G. Biddle Co.

VALVES, TRAPS AND PIPING

212 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

213 Industrial Valves — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations, describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Edward Valves, Inc.

214 For High Pressures, Temperatures — Bulletin B-453, 12 pp, describes company's high temperature and high pressure valves for service in steam power plants and related installations. Cutaway views illustrating design and construction features are included, as well as temperature-pressure ratings table, selection chart, dimensions, weights. Yarnall-Waring Co.

215 Butterfly Valve Manual — Forty-pp Catalog B-2 is designed to help power engineers select valve types, understand their characteristics, and determine space requirements. It includes such useful data as: pressure drop and flow tables, conversion tables, theory and application, recommended materials, and describes rubber seat butterfly valves from 4 in. diam up, for handling liquids and gases. The Henry Pratt Co.

216 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-

technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics covered. Crane Co.

217 Industrial Valves — Bulletin 507V illustrates and describes company's line of industrial valves for control of air, gas, liquids and solids. Features photos and descriptive detail on a variety of valves, including butterfly valves, wafer butterfly valves, treaded butterfly valves, slide valves, check valves, proportioning valves and others. W. S. Rockwell Co.

218 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and tests data is presented to show efficiency of company's silent check valves in water hammer control. The Williams Gauge Co., Inc.

219 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

220 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

222 Industrial Expansion Joints — Advantages of company's line of industrial expansion joints designed for rugged temperature and pressure extremes are detailed in this illustrated brochure. Typical applications are pictured. Solar Aircraft Co.

223 Steam Trap — Bulletin 257-B describes a steam trap which uses the kinetic energy of steam to close the valve. Features of trap are detailed, and dimensional data and specifications are included. Sarco Co., Inc.

224 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, as well as repair. Armstrong Machine Works.

225 Steam Traps — Quick Flex thermostatic steam traps for outdoor and non-freeze service are described in Bulletin 257. Itemizes typical uses for these traps. Specifications and capacities are given in tabular form, accompanied by dimensional drawings. Diagram shows recommended installation. The V. D. Anderson Co.

226 Materials for Main Steam Piping — Entitled "The Plastic Ductility of Austentic Piping Containing Welded Joints At 1200 F," this 16-pp bulletin deals with an investigation into the problem of selection of materials for main steam piping. Gives stress rupture characteristics of type 316 and 347 stainless steel piping adjacent to welded joints. Pittsburgh Piping and Equipment Co.

227 Flexible Hose, Bellows — Sixteen-pp Catalog 156 describes applications and use of flexible metal hose and bellows. Engineering specifications and sizes, pressure ratings, materials and fitting attachments are included. Detailed drawings and

CHECK *the Advantages of* GOODALL *Rubber* EXPANSION JOINTS

Goodall Expansion Joints have not only the advantages stemming from the natural characteristics of rubber for all types of installations, but, what's more important, they have back of them Goodall's engineering skill, manufacturing experience and reputation for quality that give added assurance of exceptional service under all conditions.

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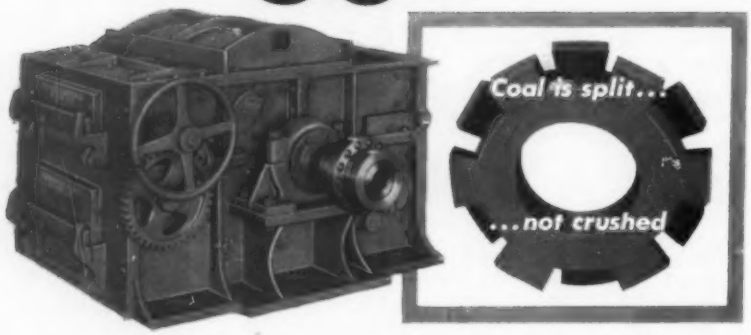

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pictures facilitate specification of individual applications. Flexonics Corp.

228 Insulated Piping — Bulletin 57-1, 24 pp, on prefabricated insulated piping systems, shows typical uses for Hel-cor pipe units for underground or overhead pipe systems. Also describes Utilidor conduits for protection of underground utility services. Sample specifications are given, along with conduit sizing charts. Ric-wil, Inc.

229 Swing Joints — Eight-pp Catalog 400-A describes a line of ball bearing type swing joints specifically designed for loading and unloading lines handling oils and gasoline, gas and many chemicals. Dimensions and specifications are included, applications detailed. Barco Mfg. Co.

PUMPS, PUMPING

230 For Abusive Pumping Jobs — This Pump Selector covers centrifugal pumps for wide industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

231 Non-Clog Pumps — Bulletin 121MV features Mono-Vane single passage impeller pumps designed for handling heavy settleable solids, long stringy solids, effluent etc. Both horizontal and vertical types are presented along with specifications. Mono-Vane impeller is described in detail, and various models of the pumps are pictured. Aurora Pump Div., The New York Air Brake Co.

232 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water testing systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating included. Milton Roy Co.

PACKINGS, SEALS

233 Mechanical Packings — Catalog P-210C contains 40 pp of detailed information on company's line of mechanical packings and gasket materials. It contains illustrations, descriptions, complete service recommendations and specification charts. Raybestos-Manhattan, Inc

234 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered. The Belmont Packing & Rubber Co.

235 Sheet Packings — Eight-pp illustrated Bulletin P-238 gives detailed specifications, engineering, application and testing data on industrial sheet packings. Nineteen varieties covered are fabricated

from asbestos, rubber, Neoprene, silicone, fiber, Teflon, other materials, covering a range of services. Crane Packing Co.

MECHANICAL POWER TRANSMISSION

236 Sprockets, Couplings — Bulletin A-644B, 32-pp, contains full description, including engineering drawings, installation photographs, prices, selection data and advantages of this company's line of roller chain sprockets, chain, and chain couplings. All feature Taper-Lock bushings for mounting easily and securely on shafts. Dodge Mfg. Corp.

237 Self-Aligning Couplings — Featured in this illustrated bulletin are company's self-aligning forged steel couplings designed to transmit maximum torque indefinitely. A cutaway view showing component features and tables of ratings are included. Koppers Co., Inc.

238 Controlled Speed Systems — Eight-pp Booklet F-1952 describes typical installations for controlled automatic variable speed systems, including control of liquid level, pressure, rewind tension, speed sensitivity, load, position or link synchronization, temperature, multiple drive conveyors, wide range speed, others. Provides information on determining preliminary planning and obtaining maximum operating efficiency. U. S. Electrical Motors Inc.

239 Power Transmission Equipment — Bulletin 7900-BIP, 12 pp, is designed as a general catalog on mechanical power transmission equipment. Contains selection charts for heavy duty QD sheaves, light weight and QD Junior sheaves, V-belts, and variable speed drives, including all-speed drives, motor drives, and pulleys. Worthington Corp.

BOILERS, GENERATORS

241 Fire Tube Boilers — This 12-pp catalog describes Superior Compact packaged boilers in capacities from 20 to 200 bhp. Interesting arrangement of text, illustration and color is used to explain many features of the units. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

242 Package Boilers — This 12-pp booklet on package steam generators describes the formulas behind all package steam generators, and illustrates how installation of a package steam generator can raise steam capacity in an existing boiler room. Cyclotherm Div., National-U. S. Radiator Corp.

243 Steam Generators — Bulletin 55-1, 22-pp, describes company's products and services, including not only steam generators but also custom metal fabrication. There are many photos of boilers in various stages of assembly. Engineering drawings of boilers producing up to 500,000 lb of steam per hr on standard fuels are included, as well as illustrations of units for waste heat application and those designed to utilize refuse for fuels — wood chips, coffee grounds. The Wickes Boiler Co.

244 Packaged Steam Generator — Advantages of company's baffleless, pressurized two-drum water tube packaged units are detailed in 12-pp Catalog SB-59. Features of the completely integrated gen-

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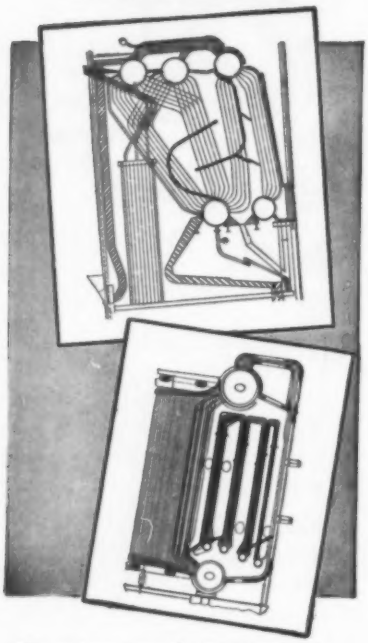

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erating plant, which requires no field piping, wiring, brickwork or special foundation, are shown on cutaway illustration. Erie City Iron Works.

245 Steam Generators — Twelve-pp Bulletin PSG-2 contains design and construction details on company's package unit steam generator — a vertical, bent tube, longitudinally fired water tube boiler. Capacities, dimensions and weights are tabulated and drawings, diagrams and photos showing fabricating methods included. Henry Vogt Machine Co.

246 Boilers for Many Services — This general product data catalog in loose-leaf notebook form contains detailed literature on company's line of boilers for heating, power and process steam. It contains separate data sheets for each product, including high pressure boilers, low pressure boilers, boiler-burner units, water-tube boilers, water heating equipment and others. In addition to photos and diagrams illustrating design and operation features, it provides tabulated engineering data. Kewanee Boiler Div., American-Standard.

247 Self-Contained Boilers — Bulletin AD-162, 8 pp, describes company's complete line of self-contained boilers for heating and processing steam or hot water. Design features and advantages are detailed and a cutaway view showing flow of air in the forced draft system is included. Cleaver-Brooks Co.

248 Integral-Furnace Unit — Bulletin G-94 describes the Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr. at pressures to 1150 psi and temperatures to 900 F. Includes information on membrane wall, integral combustion air duct and preassembled boiler components. The Babcock & Wilcox Co.

TUBING AND ACCESSORIES

249 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

Postage-free cards for ordering catalogs are on page 106. You may also use the cards to order literature mentioned in the ads.

250 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and plates for condensers and heat exchangers. Fields of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. A section of physical properties and data included. The American Brass Co.

251 Tube Expanders, Cutters — Catalog 81, 32 pp, contains specifications

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of company's line of tube cutters and expanders for fire tube and water tube boilers, condensers-coolers, heat transfer units, refinery still tubes, others. Also gives necessary information on operating accessories. Many excellent demonstrations of product application are included among the 300 illustrations provided, as well as tables of sizes. The Gustav Wiedeke Co.

252 Electric Tube Cleaners — Bulletin E107 describes advantages and applications of company's electric tube cleaners for boilers, condensers, evaporators, and heat-exchangers. Tables are included giving complete specification details. Elliott Co.-Roto Plant, Div. of Carrier Corp.

253 Tube Expanders — Catalog 88, 119 pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is described, application and engineering data included. Thomas C. Wilson, Inc.

254 Tube Expansion Control — Bulletin 64 describes a tube expansion control which automatically controls expansion by accurate measurement of torque. Advantages are detailed and specification data furnished. Airetool Mfg. Co.

FUEL BURNING EQUIPMENT

255 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

256 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

257 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

WATER CONDITONING

259 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800 compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use two-bed, three-bed, four-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

260 Demineralization Data — Bulletin WC-111A, 32 pp, is company's re-

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In Airetool automatic tube expansion controls, precise electrical "feel" replaces inexact manual "feel" and human error! This assures uniformly accurate tube rolling at a high rate of production . . . even with semi-skilled crews. For example, a coppersmithing company rolled-in 850 four inch OD, 13 gage copper tubes in 5 hours — one every 20 seconds — using Airetool's automatic tube expansion system.

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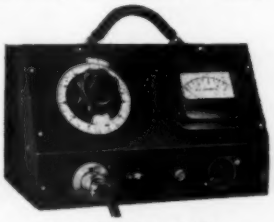

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vised booklet on demineralization (ion exchange). In addition to basic sections on application of demineralizers, principles of operation and chemistry of ion exchange resins, this bulletin includes detailed information and charts on design and materials of construction. Includes comparison charts on multi-bed, mixed-bed and scavenger or polishing demineralizers. Detailed layouts of each type of system are provided. Graver Water Conditioning Co.

When ordering catalogs, allow time for us to relay your requests to the manufacturers—and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

261 Evaluating Steam Purity — Technical Paper 135, entitled "Conductivity vs Sodium by Flame Spectrophotometry In Steam-Purity Studies," discusses results of laboratory and plant work to indicate that sodium is extremely valuable in evaluating steam purity. Performance curves are included in the paper. Betz Laboratories, Inc.

262 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW-7. Economy and operation, handling of the Deoxy-Sol, methods of anaylsis and other details are covered. A bibliography lists supplementary reading. Fairmont Chemical Co., Inc.

263 Cooling System Treatment — Bulletin C1 describes advantages of company's treatment for cooling tower systems with synergised polyphosphates. Details of the system are fully covered. National Aluminate Corp.

264 Mixed-Bed De-Ionizers — Practical equipment for mixed-bed de-ionization of flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation operation. Illinois Water Treatment Co.

265 Corrosion Inhibitor — Bulletin 420-12-9 describes manufacturer's Composition TG, a sodium-zinc hexametaphosphate corrosion inhibitor for water systems, stressing its superiority in controlling corrosion in water mains and cooling equipment. Provides comparative graphs showing flow coefficients, rate of film formation as determined by weight loss and current flow, and schematic drawings of feeding methods. Calgon Co., Hagan Chemicals & Controls, Inc.

266 pH and Chlorine Control — The 13th (1957) edition of company's handbook, "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium magnesium, silica nitrate hardness. Available to qualified power engineers, please state your job title. W. A. Taylor Co.

267 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and nondeaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

268 Consulting Service — Advantages of company's consulting service are detailed in 8-pp Bulletin 5006-A. How the service is qualified to solve problems concerning scale and corrosion control in boilers, cooling systems, and process waters is discussed. Dearborn Chemical Co.

LUBRICATION

269 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

270 Lithium Greases — This product information bulletin presents manufacturer's six Litholine industrial greases, stressing industry advantages offered by these multi-purpose greases. Gives properties of the greases, general application and performance characteristics and includes test data. Sinclair Refining Co.

271 Lubricants — Specification, Classification — Vital information on selection of lubricants is presented in 10-pp Vol. 41, No. 4 of "Lubrication." Covers

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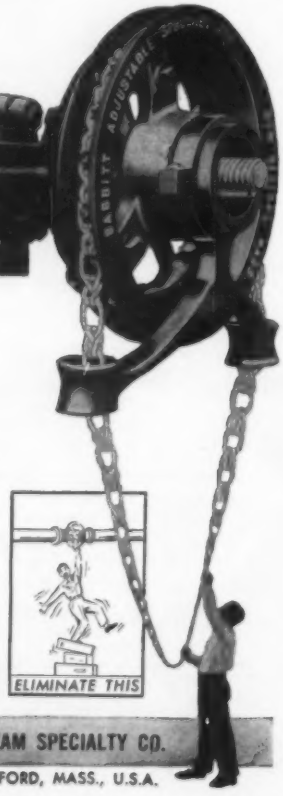

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such items as performance specifications, initial suitability of lubricants, quality of lubricant, effect of lubricant on production, effect on maintenance, effect on power, effect on cost, and features a look to the future. The Texas Co.

COAL AND ASH HANDLING

272 Improved Crushers — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

273 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

274 Spreader Stoker — Advantages and features of company's continuous ash discharge spreader stoker are detailed in 24-pp Bulletin 40. Illustrates and describes operation details, and includes diagrammatically illustrated specifications, schematic diagrams showing installations with various types of boilers, and photos of typical installations. Detroit Stoker Co.

275 Why Stainless-Clad Steel — Advantages of stainless-clad steel for coal handling equipment are detailed in this 16-pp bulletin. Photo-stories of typical applications in hoppers, chutes, bunker noses, pipes and spreaders are included. Lukens Steel Co.

REFRACTORIES, INSULATIONS

276 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

277 Refractory Mortar — This is a 24-pp manual covering the use of Lumnite calcium-aluminate cement as a mortar mix for gun-applied linings in power plant, refinery and metalworking equipment. Includes data on mortar preparation, placing procedures, curing; also general instructions, and information on use of Lumnite cement as a masonry mortar for laying brick. Universal Atlas Cement Co.

278 Pipe Insulation — This 40-pp catalog was designed as a reference guide to company's pipe insulation, presenting a new way to specify proper thickness for pipe insulation, based in the "J" factor. This special index eliminates complicated computation formerly required to determine economical thicknesses. The book also features detailed drawings that show how single-layer insulation is applied to various vertical and horizontal expansion joints as well as to pipe bends, flanges, fittings. Union Asbestos & Rubber Co.

279 Underground Pipe Insulation —This illustrated bulletin discusses the problems of underground pipe insulation

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It is increasingly difficult to get a tight seal without undue friction, under the extremes of heat and pressure common in today's industry.

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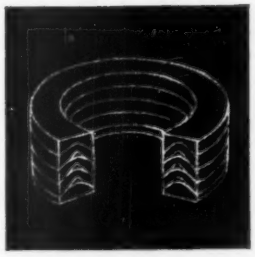
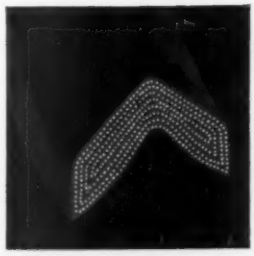


R/M Vee-Flex® Packing Rings can withstand the high pressures and temperatures that meet your specific need. Unique design seals in pressure, reduces friction.

R/M PROVIDES PRECISION MOLDING



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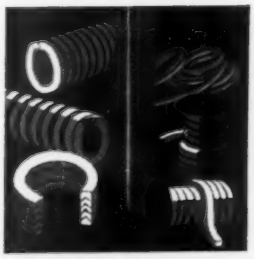

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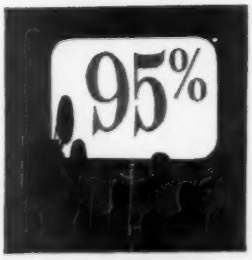

Color movie is part of R/M Packing Clinic. Learn how three or four R/M Big 7 Packing Types may meet 95% of your needs. Ask your authorized R/M distributor for a showing!

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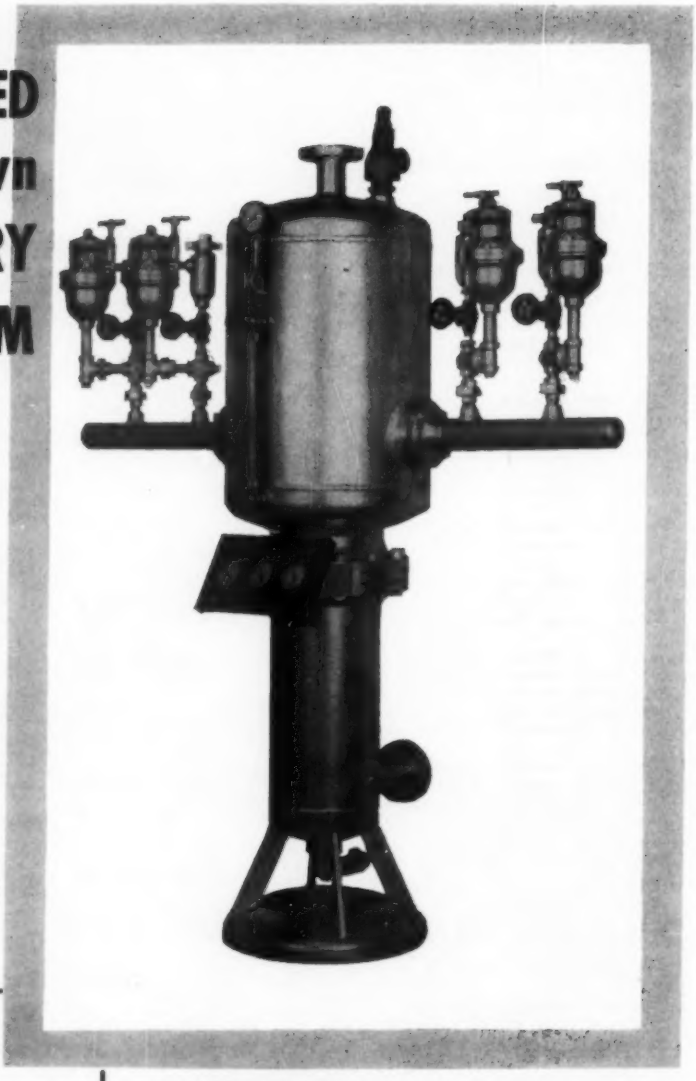
NEW PACKAGED Continuous Blowdown HEAT RECOVERY SYSTEM



Madden Package Heat Recovery Systems are designed with the Operating Engineer in mind. Once the blowdown water leaves the boiler, it travels in only one direction . . . down. The result is no mud traps, no clogging and CLEANING IS ELIMINATED.

Accurate, wide range flow control with the Madden Orifice Meter. The heart of this device, the Orifice Plate, is GUARANTEED FOR TEN YEARS against cutting, wire drawing or any other distortion. The amount of blowdown becomes a definite and known quantity. Four different Orifice Plates, each with 17 orifices, are available to meet varying requirements.

The NEW Madden Balanced Pressure Float Valve located in the flash tank is constructed with a stainless steel mechanism, including the float ball. This valve allows the correct flow of blowdown water to escape at all times to the heat exchanger tubes, thereby providing a flushing action. Only Madden provides SELF FLUSHING and GRAVITY FLOW.

Boiler capacity usually expands in proportion to factory capacity and the Madden System also has this ability to grow but without the addition of new units. ONE HEAT RECOVERY SYSTEM CAN BE OPERATED WITH AS LITTLE AS ONE BOILER AND AS MANY AS SIX! Top efficiency can be expected through its complete capacity range.

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and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

280 Pipe Insulation — Featured in brochure J-432 is a lightweight, flexible, one-piece pipe insulation composed of incombustible, moisture-resistant mineral wool fibers, bonded with a phenolic resin and molded into 6-ft long sections. Characteristics of the material are described and a table of recommended thicknesses included. Baldwin-Hill Co.

OTHER EQUIPMENT

281 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

282 Insulated Stack — This illustrated folder on company's pre-cast insulated stack contains complete product information, including advantages and description, specifications, suggested installation methods. Van-Packer Corp.

283 Steel Plate Construction— Pictured and described in this 20-pp bulletin are some of the steps in the fabrication of steel plate into boiler breechings, casings, duct work, stacks and special shapes, from initial design stage to final erection at plant site. The bulletin is generously illustrated with photos of typical plants utilizing these fabrications. They cover a wide range of industries, including paper, petroleum, steel, as well as utilities. Connery Construction Co.

284 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters, explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

285 Process Equipment — Bulletin G-3B describes equipment for process industries, including pneumatic conveying systems, compressors and vacuum pumps, coolers and preheaters, blowers, gas and vacuum pumps, fans and gas washers, accessories. In addition to describing features and advantages of the equipment, bulletin includes engineering data tables, photos and drawings. Fuller Co.

286 Aluminum Jacketing — Bulletin 530a describes company's line of aluminum weather-proof jacketing for insulated lines, towers, vessels and tanks. Application procedures are pictured and suggested specifications offered. Childers Mfg. Co.

287 Thread Compound — Bulletin C-5 describes Fel-Pro, a high temperature thread compound to prevent seizing and galling of metal surfaces up to 1800 F. Gives advantages of the compound and instructions for use. Application suggestions given for refineries, chemical plants, steel mills, power plants, and other sites. Felt Products Mfg. Co.

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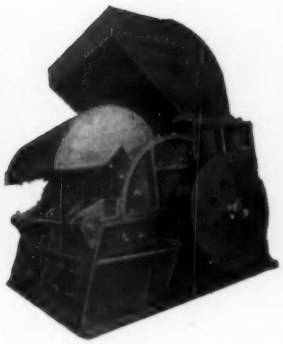

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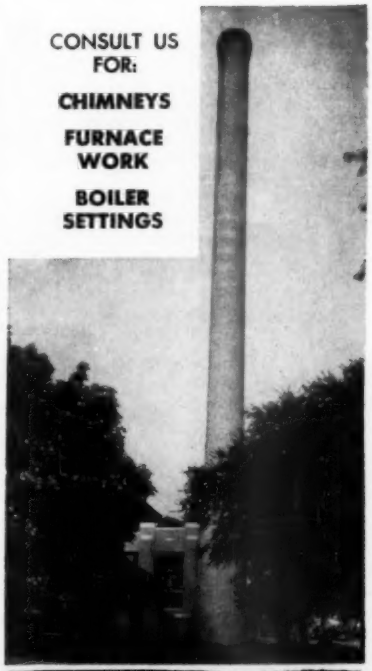

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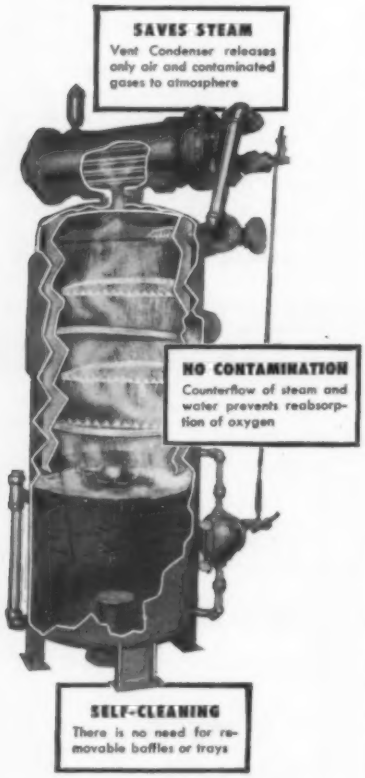
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288 **Equipment Selector Charts** — Bulletin CE-50, 20 pp, contains selector charts on corrosion-resistant equipment for process industries. Tables cover general considerations in selection of material, physical properties, corrosion resistance, techniques and skill in manufacture of equipment. Describes rubber and plastic pipe, tubing and fittings; valves; pumps; as well as lined tanks. Amerace Corp, American Hard Rubber Co.

289 **Steam Engines** — Bulletin 308, 8 pp, describes features and advantages of company's line of vertical type steam engines. Sectional drawings and engineering data table are included, as well as descriptions of construction details. Troy Engine & Machine Co.

290 **Dust Control System** — Twelve-page Bulletin CJ-1 details advantages of dust control through preventive techniques with company's Chem-Jet system. Describes principle of the system which uses a surface-active compound to prevent dust from becoming airborne. Operation, basic techniques, and installation of the system are covered. Johnson-March Corp.

291 **Ventilation Units**—Bulletin FM-315, 25 pp, describes basic construction of company's package propeller fans for commercial and industrial applications. Illustrated case histories of typical installations are included, as well as performance data. Buffalo Forge Co.

292 **Overhead Heating Units**—Bulletin P 1-57, 16-pp, contains photographic reproductions of overhead gas-fired heaters, as installed in a variety of commercial and industrial plants. How this type of heating solved specific heating problems is told. Prat-Daniel Corp.

293 **Corrosion, Abrasion Control** — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available. Goodall Rubber Co.

294 **Better Fuel Performance** — This bulletin describes two of company's products designed for better fuel performance and economy. The first is a fuel oil sludge dispersant which prevents sludge and moisture separation in heavy fuel oil. The other is a soot remover. Western Chemical Co.

296 **Steam Turbines** — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

297 **Valveless Filter** — Operation of company's automatic valveless filter is described in this 8-pp illustrated bulletin. Applications and typical operating conditions are detailed and diagrams and photos are included. The Permutit Co.

298 **Is Salt Just Salt?** — This is the title of an 8-pp bulletin describing salt characteristics and properties as well as geographical distribution. Variations in salt from different areas in the United States are illustrated and company's refined products described. Morton Salt Co.

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● 1 — B & W Sterling boiler, new 1937, four drums, 336 — 3¼" dia. tubes, 3458 sq. ft. heating surface, 350 hp, 160-lb. pressure, State Registration No. 60465.

● 1 — B & W Sterling water-tube boiler, 1934, 3-drum, 210 — 3¼" dia. tubes, 2046 sq. ft. heating surface, 200 hp, 160-lb. pressure, State Registration No. 57892.

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In both cases, communicate with the breweries for additional information and option for inspection. Offers are subject to prior sale.

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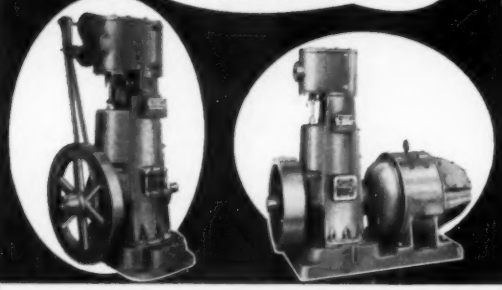

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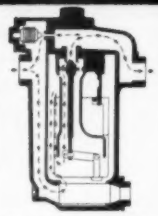
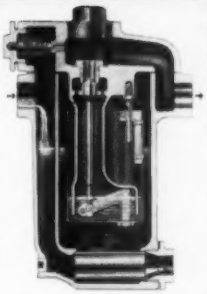


Warm-up speeded by discharge through by-pass as well as main orifice.



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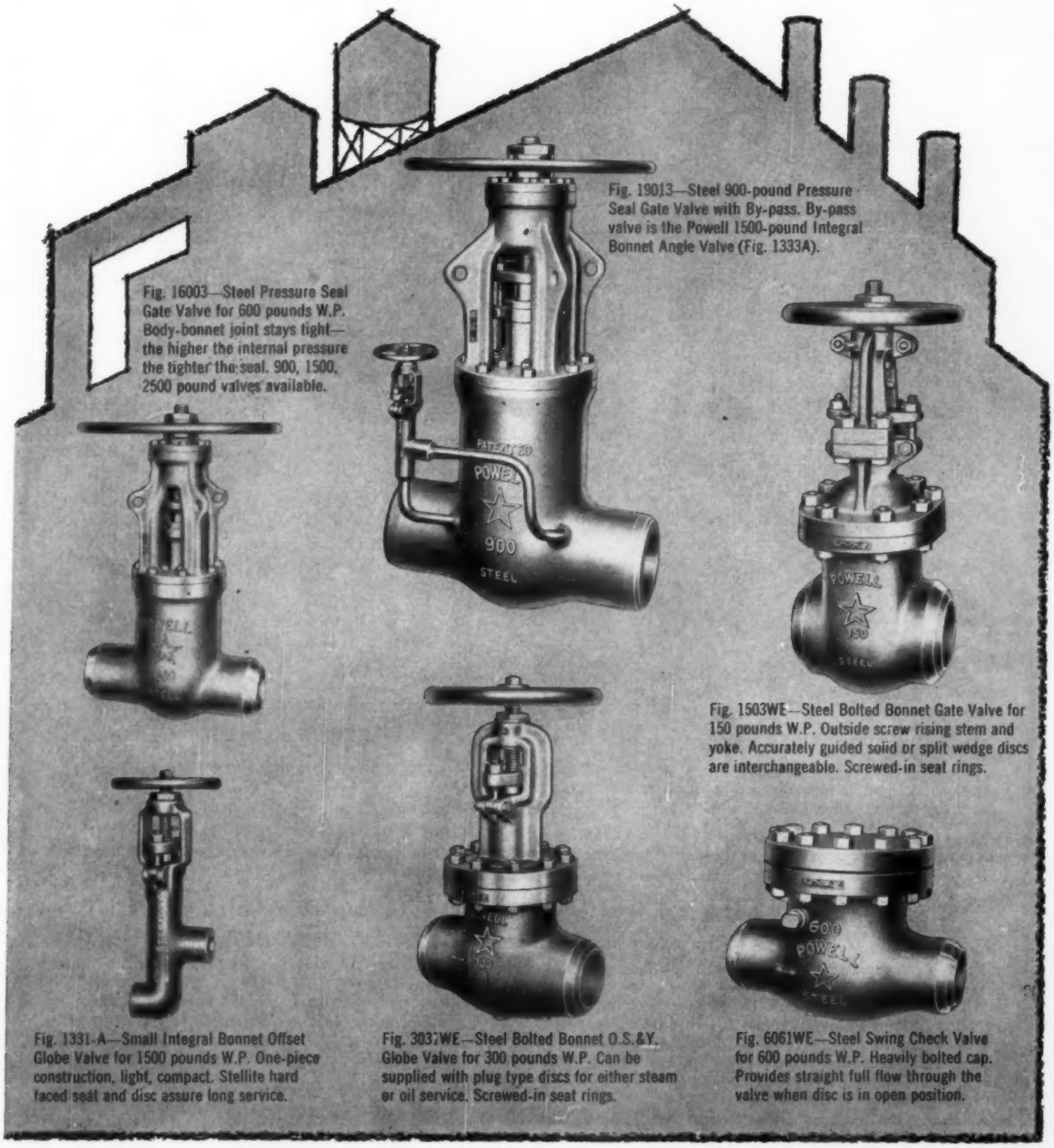

Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).

Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.

Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.

Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.

Fig. 3032WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.

Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

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THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

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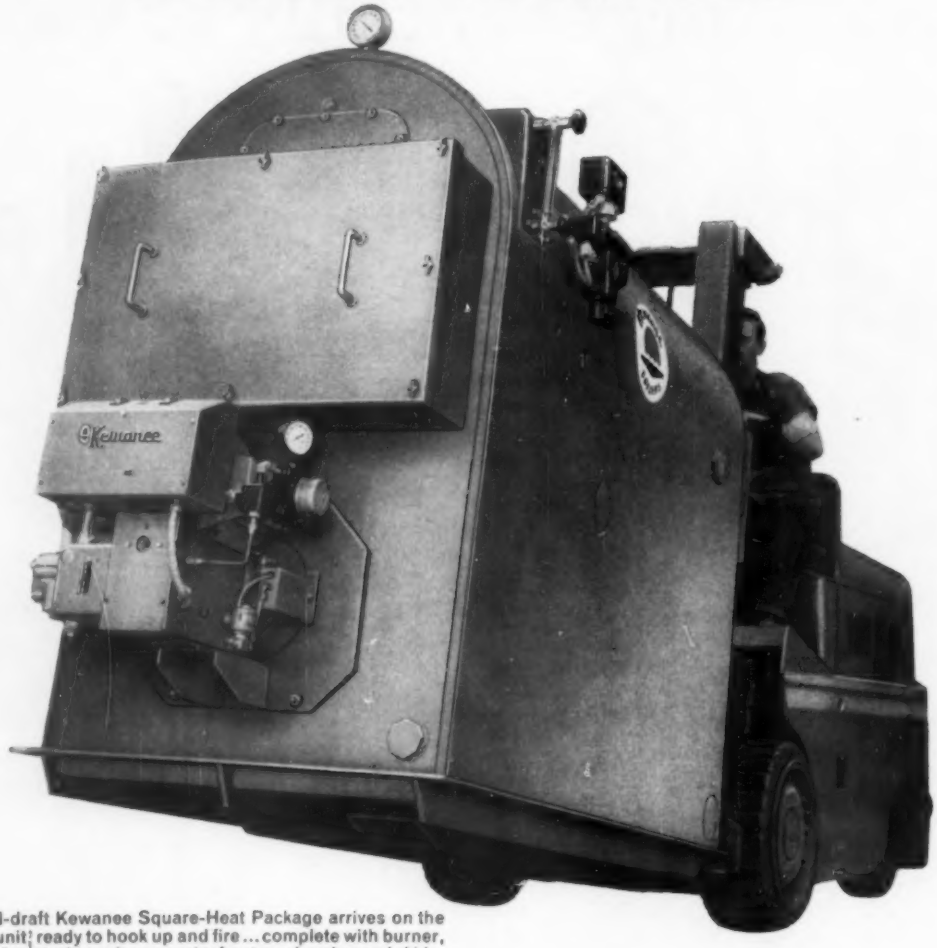
NOW . . . FORCED-DRAFT FIREBOX PACKAGES



Forced-draft Kewanee Square-Heat Package arrives on the job as a unit, ready to hook up and fire ... complete with burner, pre-wired control panel, pre-cast refractory chamber and skids. It requires no crating...no job-site insulating.

KEWANEE® SQUARE-HEAT GAS-OIL UNITS

for 15 lb. steam or 30 lb. water, 216,000 to 1,800,000 Btuh

For the first time, Kewanee offers a fire-box package boiler! The new Square-Heat Packages are forced-draft, requiring only a stub vent—no high stack. Kewanee's new combination gas-oil burner fires natural, mixed or L.P. gas . . . No. 1 or 2 fuel oil. One switch changes fuels . . . automatic changeover is available. An exclusive air distribution system pre-mixes gas and air before it enters the combustion chamber, for smoother and more efficient firing.

Along with the new burner is a new pressure-tight front flue cover dogged down by easily removed wing nuts . . . and a new, standard-equipment, wrap-around insulated jacket of heavy-gauge steel. Retained in the new units are Square-Heat's compact design, large firebox, widely spaced 3" fire tubes, large disengaging area and ample steam space.

For complete facts see your Kewanee Man or write: AMERICAN-STANDARD*, KEWANEE BOILER DIVISION, 113 Franklin Street, Kewanee, Illinois.

See this new Square-Heat unit among the display of Kewanee forced-draft packages at Booth 134, Power Show, New York Coliseum, December 1-5, 1958.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
KEWANEE BOILER DIVISION

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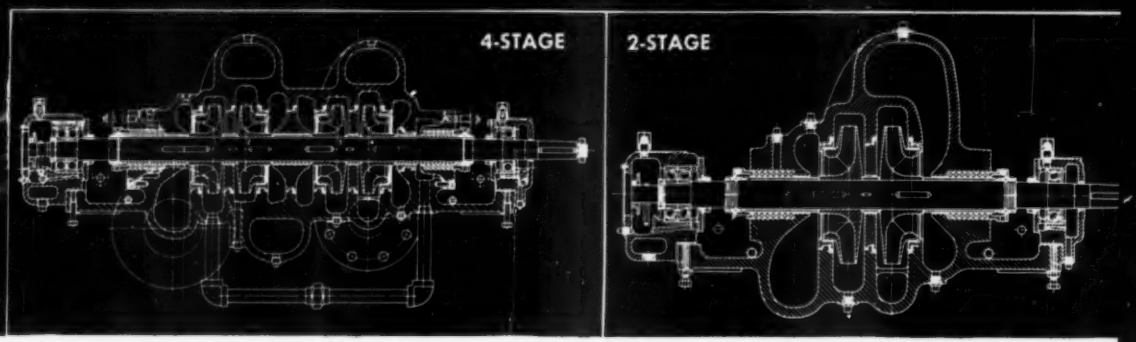

On 2- and 4-stage centrifugal pumps

WORTHINGTON SAVES YOU 10 to 30%

▶ **Elastic Seal Rings**—inserted into casing rings, end leakage problems, maintain peak initial and sustained efficiency—an exclusive Worthington feature. Designed to resist constant casing ring wear. These seals are standard on all UNB, UNQ pumps.

▶ **Advanced Design**—typical of the many advanced design features on these pumps is the liberally proportioned shaft which minimizes deflection and eliminates vibration. There is always a safe margin between deflection and clearances.

▶ **Complete Pump Experience**—a combination of Worthington 'know-how' and 118 years of extensive design, testing, and manufacturing skills on the world's broadest line of pumps for every conceivable purpose and application.

turn page to calculate your pump needs▶

Worthington's standard 2-stage UNB and 4-stage UNQ centrifugal pumps are basic for boiler feed pump and general service applications. They are built to exacting standards of dependability and long life. Each combines the engineering ideal of positive interstage leakage control, balanced design, and designed-in reliability. Delivery is competitive. And these pumps cost 10 to 30% *less* than previous models!

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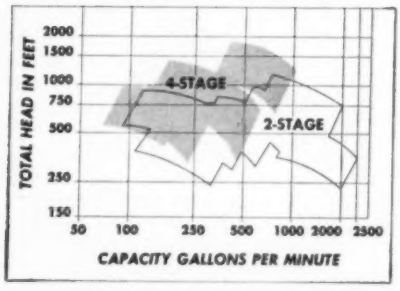
New Worthington 2- and 4-stage centrifugal pumps let you

SAVE UP TO 30% PER PUMP!



2-STAGE & 4-STAGE COVERAGE CHART

Now Worthington—a respected name in pump manufacturing for 118 years—offers you savings of 10 to 30% on both 2-stage and 4-stage centrifugal pumps. These are the same totally-engineered, constantly checked and skillfully manufactured pumps used in every conceivable application throughout industry. They feature the same careful attention to detail: balanced design, elastic seal rings, oversize ball bearings, sturdy construction, easy accessibility. They represent the same extensive experience in design, construction and service found in every Worthington pump.

You can put this Worthington experience to work on your pump application problems right now. Simply send in the card below for a fast quote on any specific standard fitted pump requirement. All the information needed for selection and application is included. There is no obligation on your part, of course. With each quotation we send free elastic seal ring. Tear out and mail card now!

21-3

Driver Data (motor or turbine)_____

Pumping Application_____

Design Data

Capacity (gpm)_____

Total Head (feet)_____

Suction Head (psig)_____

or

Suction Lift (feet)_____

Pumping Temperature (°F)_____

Liquid to be Pumped_____

Name_____

Position_____

Name of Firm_____

Address_____

City_____ Zone_____ State_____

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Typical of Worthington's advanced engineering techniques is the elastic seal ring. Able to withstand severe hydraulic shock, designed to resist constant casing ring wear, yet resilient enough to permit a few thousandth of an inch slippage where needed. These seal rings are standard on all Worthington UNB and UNQ pumps. Examine one for yourself free by filling in card for quotation and mailing now. No postage required.

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